WEST BRANCH DUPAGE RIVER

Biological and Water Quality Study of the East and West Branches of the DuPage River and the Salt Creek Watersheds

Cook, DuPage, Kane and Will Counties, Illinois

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Submitted to:

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Technical Report MBI/2008-12-3

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December 31, 2008

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Acknowledgements

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FOREWORD

What is a Biological and Water Quality Survey?
A biological and water quality survey, or "biosurvey", is an interdisciplinary monitoring effort coordinated on a waterbody specific or watershed scale. This may involve a relatively simple setting focusing on one or two small streams, one or two principal stressors, and a handful of sampling sites or a much more complex effort including entire drainage basins, multiple and overlapping stressors, and tens of sites. The latter is the case with the DuPage River and Salt Creek biological and water quality study in that there were three distinct subwatersheds and a complex setting with multiple and overlapping stressors and sources involved. This is a baseline assessment of existing conditions and is the first such effort of this magnitude that we are aware of in these watersheds. Previous surveys and assessments by Illinois EPA and DNR were done at a much less intense spatial scale. While the principal focus of a biosurvey is on the status of aquatic life uses, the status of other uses such as recreation and water supply, as well as human health concerns, could also be potentially addressed.

Scope of the DuPage River-Salt Creek Biological and Water Quality Assessment
Biological, chemical, and physical monitoring and assessment techniques were employed in order to meet two major objectives: 1) determine the extent to which biological assemblages are impaired (using Illinois EPA guidelines), and 2) determine the categorical stressors and sources that are associated with those impairments. The data gathered here was processed, evaluated, and synthesized as a biological and water quality assessment. As such this study contains a summary of major findings and recommendations for future monitoring, follow-up investigations, and any immediate actions that may be needed to resolve readily diagnosed impairments. It was not the role of this study to identify specific remedial actions on a site specific or watershed basis. However, the baseline data established by this study should provide a firmer basis for developing these types of remedial projects in the future.

Introduction

In 2005 the DuPage River Salt Creek Workgroup (DRSCWG) contracted with the Midwest Biodiversity Institute (MBI) to carry out the data collection and analysis necessary to fulfill the requirements of the DRSCWG watershed-based biological assessment plan (MBI 2006a). Under the plan, a framework for collecting biological, physical and water chemistry samples for the basins of Salt Creek and the West and East Branches of the DuPage River was developed.

During the summer-early fall period of 2006 (West Branch) and 2007 (Salt Creek and East Branch) biological and chemical samples were collected, and physical measures taken from a total of 118 sampling locations including six reference sites.

The information gathered during these surveys represents a baseline of existing conditions, documenting current and past environmental impacts to the reaches from both point source discharges and nonpoint source pollution. Secondly the data gathered can be analyzed in such a way as to guide management decisions for effectively implementing the recommendations provided in the Total Maximum Daily Load (TMDL) reports for each subwatershed amongst other possible management goals. The bioassessment plan (MBI 2006a) described spatial and temporal sampling designs and the indicators and parameters to be collected at each sampling site. It also detailed the type of biological sampling methods for fish and macroinvertebrate assemblages and habitat assessment to be employed. The sampling design employed a combination of systematic and targeted-intensive site selection.

Sample sites (Figure 1) are selected by systematically starting at the downstream terminus of the watershed, and selecting the next upstream site at a fixed interval of one-half the drainage area. Thus, the upstream drainage area of each succeeding point, as one moves upstream, decreases by 50%. This resulted in seven levels of drainage area, starting from 150 $mi.^2$, through drainage sizes of 75, 38, 19, 9, 5 and finally 2 mi^2. Each level was then supplemented with targeted sites that were situated around points of particular interest such as the outfalls of publicly owned treatment works (POTW), sewer overflows, major stormwater sources, and dams. The number of targeted sites added to this grid is dependent on the density of the sources of interest.

Specific objectives of this study were to:

1) Complete a comprehensive assessment of biological assemblages (fish and macro-invertebrates) and habitat within the targeted watersheds.

2) Establish a baseline for comparison to future conditions in response to management activities.

3) Determine the role of potential stressors at the local reach scale.

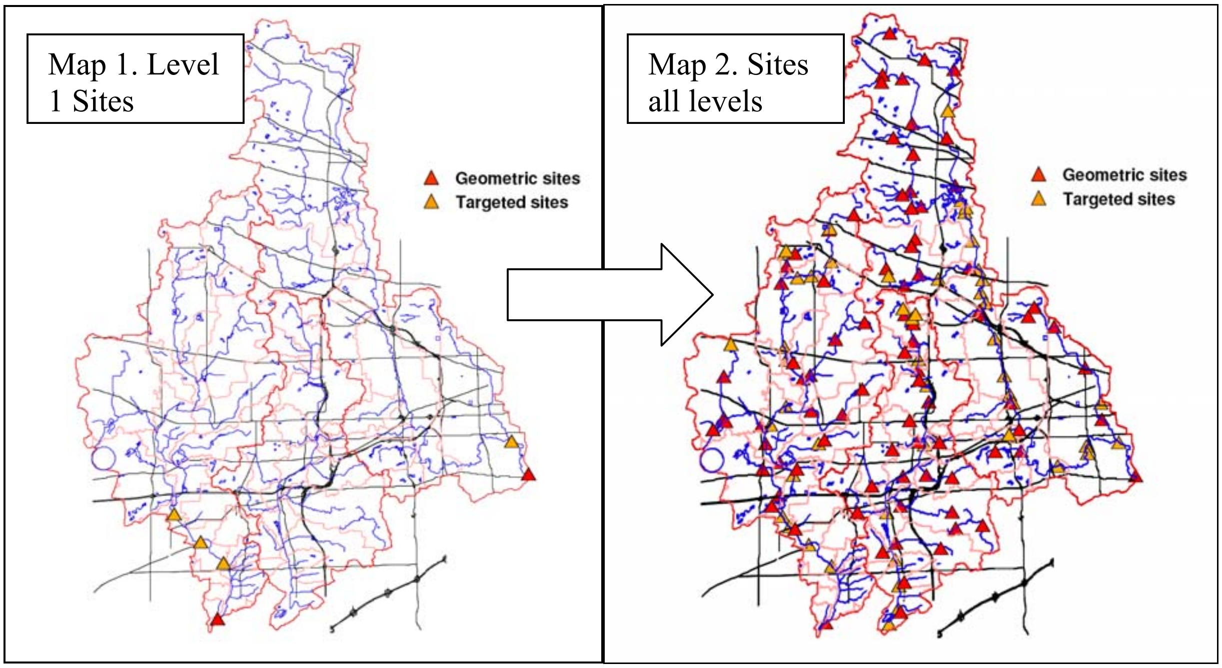


Figure 1 . The location of geometric and targeted sites throughout the DuPage River-Salt Creek study area. Sites are selected using a geometric progression of sites based on subwatershed drainage areas and proceeding trough to a drainage area of approximately 2 sq. mi. There were seven levels of drainage areas ranging from 150 mi² for the West Branch and Salt Creek subwatersheds to 75, 38, 19, 8, 4, and 2 mi² levels in all 3 subwatersheds. Targeted sites are added to ensure that specific sources and places are sampled and pollution gradients are detected.

Summary

Biological communities inhabiting streams draining the DuPage-Salt Creek study area were limited primarily by stormwater impacts and habitat alterations, secondarily by sewer overflows, and indirectly by wastewater loadings. These limitations do not act singly, but often work in concert. For example, the effects of nutrient enrichment were most pronounced in impounded sections of the mainstems, where wide swings in diel dissolved oxygen concentrations often resulted in hypoxic conditions. Nowhere was this problem more manifest than in the dam pool at McDowell Grove on the West Branch, the dam pool at Churchill Woods on the East Branch where dissolved oxygen concentrations fluctuated by as much as 15 mg/l, and at the Hidden Lake Forest Preserve on the East Branch where minimum dissolved oxygen concentrations frequently fell below water quality standards during the summer months (Figure 2). Numerous stormwater detention ponds and other small impoundments in the headwaters contributed loadings of ammonia, total Kjeldahl nitrogen and oxygen demanding substances resulting in higher-than normal ambient concentrations for these parameters. Comparing the concentrations of these substances to total phosphorus concentrations by stream size reveals the spatial contribution from the diffuse headwater sources relative to point source loadings (Figure 3). Phosphorus concentrations in excess of 0.5 mg/l were the domain of treated effluent, and most of the publicly owned treatment plants in the survey area discharged to streams larger than 2 square miles in drainage area. Evidence for the stress created by urban/suburban stormwater was also manifest in elevated concentrations of polycyclic aromatic hydrocarbons (PAHs) in sediment samples collected throughout the study area. PAHs build up on road surfaces as a result of incomplete petroleum combustion and leakage. The concentrations of PAHs detected in sediment samples frequently exceeded levels where effects on benthic organisms are likely.

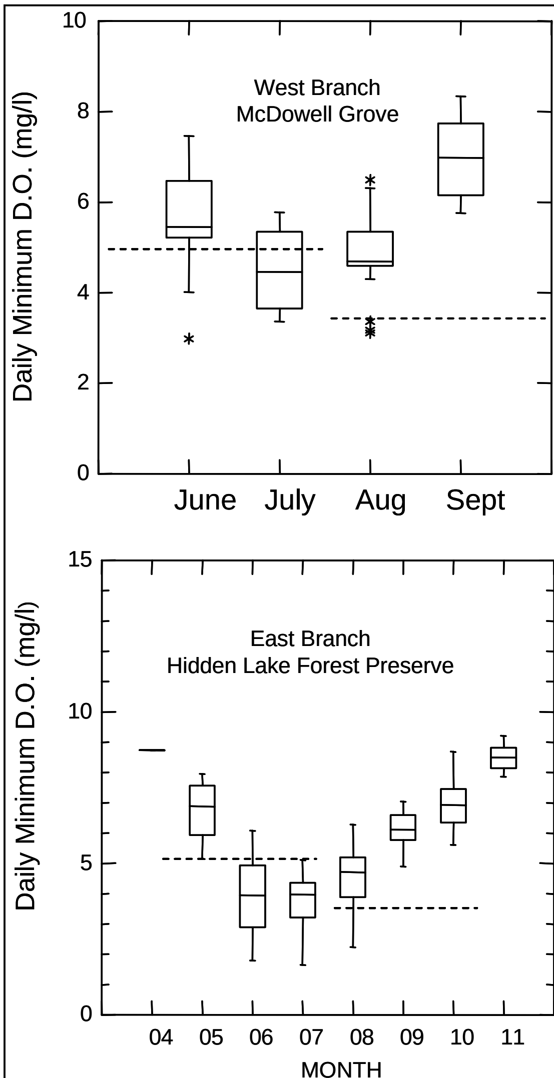


Figure 2. Minimum dissolved oxygen concentrations recorded from hourly observations in the West Branch at McDowell Grove, 2006, and in the East Branch at Hidden Lake FP in 2007. The water quality standards for seasonal instantaneous minimum concentrations are shown as dashed lines.

The biological communities were not, however, completely overwhelmed by the high degree of suburbanization in these watersheds, as habitat quality explained a significant amount of the variation in the biological indices (Figure 4). Degraded stream habitat with minimal function beyond water conveyance was frequently noted at headwater sites; however, habitat quality along the lower West Branch, East Branch and Salt Creek mainstems, exclusive of dam pools, was rated as good to excellent. Furthermore, biological communities sampled within forest preserve lands tended to score better than non-buffered sites. These results suggest that habitat restoration (i.e., both steam and riparian) is likely to have both a direct benefit in terms of biological condition, and an indirect benefit by improving assimilative capacity.

Concentrations of total dissolved solids (TDS) greater than 1000 mg/l were noted in water quality samples collected from headwater sites, especially for the Arlington Heights Branch and the Salt Creek mainstem. Concentrations of TDS greater than 1000 mg/l are toxic to certain macroinvertebrates, most notably mayflies. While specific source identification was beyond the scope of this study, treated effluent from point sources was clearly ruled-out.

An evaluation of effluent water quality data generally spanning five to ten years, submitted by publicly owned treatment works (POTWs) in the study area, indicated that treatment efficiency at all plants was generally high and effluent quality typically within applicable NPDES permit limits. There were two instances, however, where biological communities may have exhibited added stress downstream from POTWs: one in the East Branch downstream from the Bolingbrook and Woodridge WWTPs, and one in Addison Creek downstream from the Bensenville South STP. In the case of the East Branch, macroinvertebrate index of biotic integrity (MIBI) scores decreased 20 points downstream from the Bolingbrook and Woodridge plants relative to the sites immediately upstream. The habitat quality in the reach also declined, relative to upstream, lacking riffles, and the site downstream from the Woodridge plant had silt-muck substrates. Given the ubiquity of low dissolved oxygen readings recorded by continuous monitors at five locations in the East Branch, it is not unreasonable to suspect that dissolved oxygen concentrations in this reach, given the poor habitat, may have contributed to the low scores. The Bolingbrook plant was noted for having ammonia-nitrogen exceedences on two occasions between 2006 and 2007, and ammonia-nitrogen exceedences were noted for the Woodridge facility on three occasions in 2007. However, the timing (during winter), rarity, and magnitude (less than chronic thresholds) of these events, as recorded, are not likely to have caused such a precipitous decline in biological condition. Follow-up monitoring that includes both spot sampling and hourly profiles of dissolved oxygen during the summer low-flow period, more intensive water quality sampling for ammonia-nitrogen, and a visual inspection for fugitive sources is recommended for this reach. It should also be noted that given the number of plants evaluated in this study, observing occasional exceedences stemming from normal operation and maintenance is not unexpected.

In Addison Creek, high concentrations of ammonia-nitrogen were recorded in water quality samples collected downstream from the Bensenville plant. The Bensenville plant discharges to a zero flow stream, such that the plant discharge flow can circulate upstream from the plant. The watershed upstream from the plant is heavily urbanized, and has legacy sources including a scrap yard and industrial sites. As was the case for the East Branch, the rarity of exceedences clearly suggests that operational negligence is not, in any way, responsible for the exceedences.

Collectively, habitat degradation, stormwater pollution, high ambient oxygen demand and low dissolved oxygen concentrations, combined sewer overflows (CSOs), and a few instances of episodically high ammonia concentrations resulted in almost all of the study area sites being classified as impaired (i.e., non-attainment of minimum Clean Water Act goals) based on the current Illinois EPA assessment criteria. Exceptions to this pattern were a few sites located on the lower East Branch and West Branch mainstems.

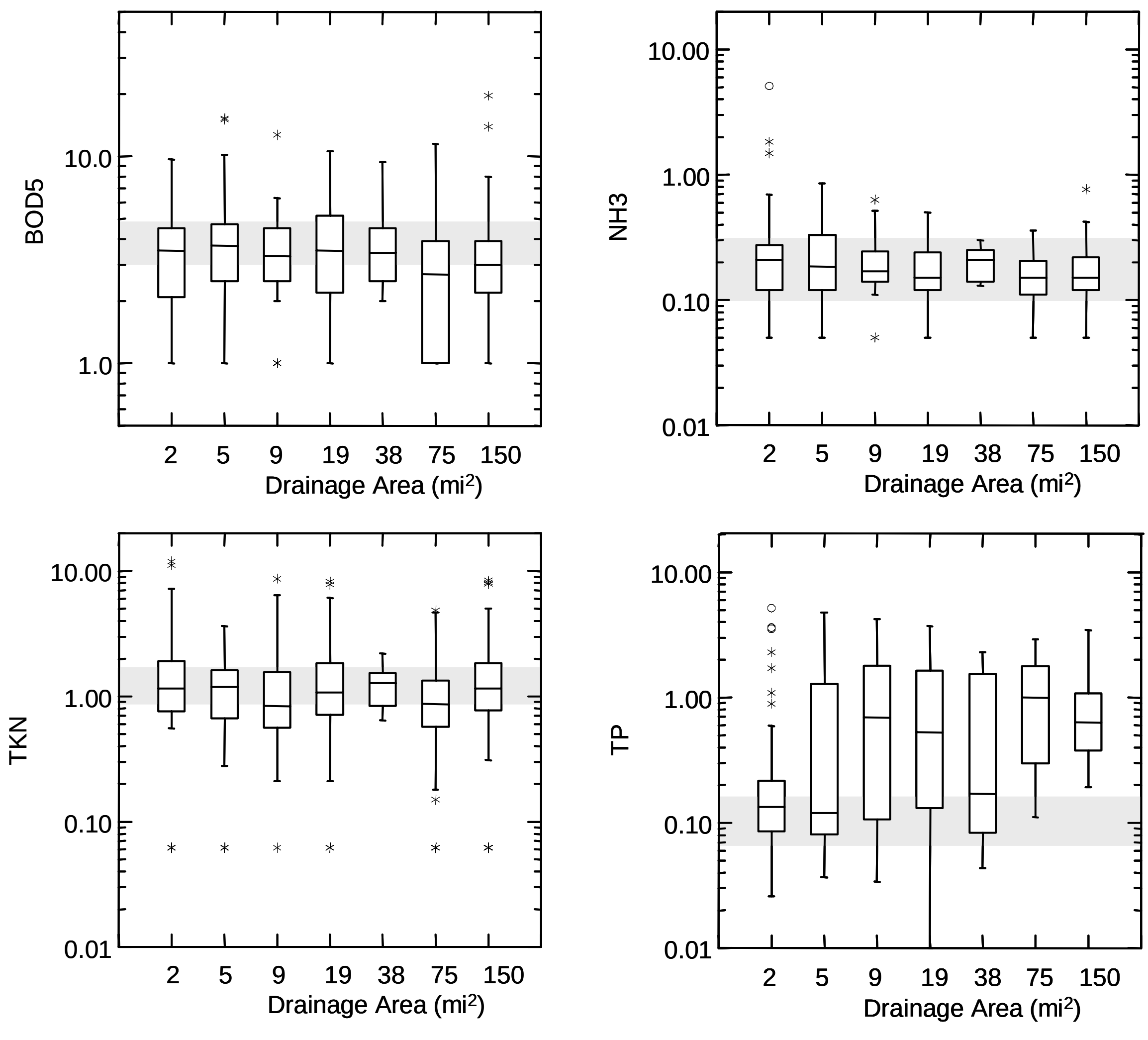


Figure 3. Concentrations of selected water quality parameters, in mg/l, measured during the Salt Creek - DuPage River watershed survey stratified by geometric stream size category. Boxes enclose the lower and upper quartiles (25th and 75th percentiles), whiskers encompass the range of the data, and outliers, shown as asterisks, are more than twice the interquartile range. The shaded area in each plot shows the upper range of concentrations typical of unpolluted waters (U.S. EPA 2004, Ohio EPA 1999, Wetzel 1981).

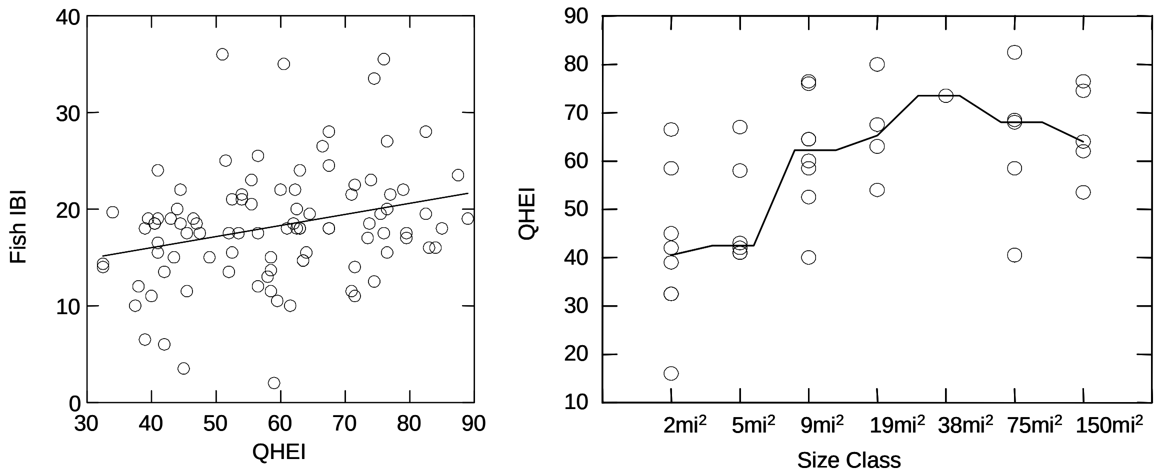


Figure 4. Left Panel - Fish Index of Biotic Integrity (IBI) scores for the Salt Creek - DuPage River study area plotted against Qualitative Habitat Evaluation Index (QHEI) scores. The trend line is from an ordinary least squares regression. Right Panel - QHEI scores for the –DuPage River-Salt Creek study area plotted by geometric stream size category. The trend line is drawn through the median value for each size category.

Relationship to Existing TMDLs

The 2006-2007 biological and water quality survey of the DuPage-Salt Creek River watershed documented how the biological communities throughout the study area are limited by multiple stressors (Table 1). The two predominant stressors are stormwater and habitat degradation. Stormwater is used here as a catchall for the suite of water quality problems associated with urbanization, i.e., the build-up and runoff of heavy metals and polycyclic aromatic hydrocarbons from roads and other surfaces, sediment, pesticides, nutrients, leaking sewers, and hydrologic instability (high peak flows and low residual base flow). The latter directly affects habitat quality by scouring and entrenching the stream channel, and indirectly because countermeasures such as revetments, dams, and channelization are used to stabilize the stream channel. All of these countermeasures are, in their own right, deleterious to aquatic life. The net result, in the extreme, is a flush of toxic stormwater flowing through degraded stream channels that have a limited capacity to support aquatic life, assimilate pollutants, and attenuate high flows.

Causes of impairment to water bodies in the DuPage-Salt Creek River study area appearing on the 2008 303(d) list of impaired waters for Illinois essentially lists the pollutants frequently associated with stormwater, i.e., heavy metals, priority organics, suspended sediment, dissolved solids, and nutrients (Table 1). However, the list gives no mention, by design, to habitat alteration as it lacks a numeric water quality standard, or other stressors that are not pollutants (e.g., low dissolved oxygen) because TMDLs in Illinois are restricted to addressing pollutants for which a water quality standard exists (i.e., low dissolved oxygen is not a pollutant, it results from pollution). Consequently, TMDLs developed for Salt Creek, the East Branch, and the West Branch have indirectly and partially addressed stormwater pollution by using either chloride or total dissolved solids (TDS) as proxies. Similarly, $cBOD_5$ has been used as a proxy for low dissolved oxygen in

TMDLs developed for Salt Creek and the East Branch. Also, habitat has been tangentially addressed in the Salt Creek and East Branch TMDLs by broaching the subject of dam removal as a means to help assimilate cBOD5 loads. Although connections to the predominant stressors identified by this study are apparent in the existing TMDLs, they are indirect and incomplete.

For example, implementation of a TDS or chloride TMDL developed to address stormwater pollution should simultaneously address co-occurring stressors, and require that remedial measures to reduce loads be distributed on a watershed basis, the pollutant-specific focus clearly side steps habitat quality, ignores impaired sites if the impairment cannot be attributed to a specific pollutant, even in cases where the cause is known (e.g., low dissolved oxygen), and may lead to spurious listings in cases where a chemical exceedence triggers a listing without corroborating biological information. Many of the pollutants listed on the 2008 303(d) list were not detected in concentrations exceeding water quality criteria in the 2006-2007 biosurvey. In this case, absence of evidence does not necessarily provide evidence of absence. Rather, it illustrates the point that reliance on pollutants and chemical criteria can be misleading. Iron concentrations exceeding 1.0 mg/l are routine in unpolluted waters, have shown little or no association with biological condition, yet constitute a water quality standard exceedence (Ohio EPA 1998). Having information from an integrated biosurvey helps to rank stressors and eliminate potentially spurious chemical exceedences. For example, copper exceedences were noted for two sites in the West Branch subbasin, yet these were not considered significant in light of the magnitude of other stressors. For many of the impaired water bodies identified during this survey, neither specific chemical pollutants nor local habitat quality could be ascribed as the cause of impairment. The impairment in these cases clearly falls under the rubric of stormwater, but also relates to watershed-scale habitat degradation.

The identification of 33 previously unassessed waters as being impaired (Table 1) highlights the importance of study design, and represents another issue of contrast between the findings of this study and the current TMDL listings. The watershed-scale, geometrically-stratified spatial monitoring design employed by this study was greater in scope than that upon which the current TMDL list was based. The most common impairment causes identified by our study for these stream segments were TDS and habitat alterations, although other pollutant causes (BOD, PAHs, ammonia) were apparent in selected streams. The simple interpretation is that more monitoring produces a longer list of impaired waters. While this certainly holds for these watersheds, the contribution of the spatial context to understanding the most limiting issues in these watersheds has, up until this study, been overlooked. This additional information provides important data and context for addressing what are essentially watershed level issues and impairments. It also contributes to addressing the important issues of restorability and attainability, the latter becoming important as Illinois considers the development and application of tiered aquatic life uses (TALU). This type of information will be useful in developing more detailed stress:response relationships in future analyses.

Table 1. Total Maximum Daily Load studies completed or under consideration for development for waterbodies in the DuPage-Salt Creek study area compared to leading causes of impairment identified in this study. Note that multiple stressors falling under the rubric of stormwater are a major cause of impairment to all waterbodies in the watershed.

RIVER/STREAM	**Causes Identified in Present Study (appear in order of proximate magnitude). Italicized causes are considered "nonpollutants," bold causes have TMDLs developed or planned.**	**Causes Appearing on 2008 303(d) List. Causes in bold have TMDLs developed or planned.**
Arlington Heights Branch Salt Creek	TDS, *Habitat Alterations*, PAHs	Not Assessed
Baldwin Creek	TDS	Not Assessed
Salt Creek	***D.O.***, **TDS**, *Habitat Alterations*, Organic Enrichment, PAHs	Aldrin, DDT, **fecal coliform**, heptachlorobenzene, mercury, PCBs, **pH**, phosphorus (total), **sedimentation & siltation, TSS**
Trib to Salt Creek (95-851)	TDS	Not Assessed
Trib to Salt Creek (95-852)	TDS	Not Assessed
Trib to Salt Creek (95-853)	TDS	Not Assessed
Trib to Salt Creek (95-855)	*Habitat Alterations*, TDS	Not Assessed
Trib to Salt Creek (95-856)		Not Assessed
Yeargin Creek	*Habitat Alterations*	Not Assessed
Ginger Creek	*Habitat Alterations*	Not Assessed
Sugar Creek		Not Assessed
Addison Creek	*Habitat Alterations*, Ammonia	Aldrin, alpha-BHC, chromium (total), copper, DDT, hexachlorobenzene, **fecal coliform**, phosphorus (total), PCBs
Trib to Addison Creek	*Habitat Alterations*	Not Assessed
Spring Brook	*Habitat Alterations*	DDT, endrin, hexachlorobenzene, phosphorus (total), **sedimentation/ siltation**
Meacham Creek	*Habitat Alterations*	Not Assessed
Oakbrook Creek	TDS	Not Assessed
Trib to Meacham Creek	*Habitat Alterations*	Not Assessed
Westwood Creek		Not Assessed
W. Br. DuPage River	***D.O.***, *Habitat Alterations*, PAHs	DDT, **fecal coliform**, hexachlorobenzene, **iron, manganese, pH,** phosphorus (total), sedimentation/ siltation, **silver**, TSS, **zinc**
Trib to W. Br. DuPage River (95 902)	*Habitat Alterations*, PAHs	Not Assessed
Trib to W. Br. DuPage River (95 904)	*Habitat Alterations*	Not Assessed
Trib to W. Br. DuPage River (95 905)	*Habitat Alterations*	Not Assessed
Trib to W. Br. DuPage River (95 906)	*Habitat Alterations*	Not Assessed
Kress Creek	*Habitat Alterations*	Not Assessed

Table 1. continued.

RIVER/STREAM	Causes Identified in Present Study (appear in order of proximate magnitude). Italicized causes are considered "nonpollutants," bold causes have TMDLs developed or planned.	Causes Appearing on 2008 303(d) List. Causes in bold have TMDLs developed or planned.
W. Br. Ferry Creek	*Habitat Alterations*	Not Assessed
W. Br. Cress Creek		Not Assessed
Bremme Creek	*Habitat Alterations*	Not Assessed
Spring Brook	*Habitat Alterations*, PAHs	Chloride, **copper**, **fecal coliform**, phosphorus (total)
Army Trail Creek	TDS, *Habitat Alterations*	Not Assessed
Armitage Ditch (trib to E. Branch DuPage)	*Habitat Alterations*	Not Assessed
Glencrest Creek		Not Assessed
Lacey Creek	TDS, BOD, *Habitat Alterations*	Not Assessed
Willoway Brook		Not Assessed
22nd St. trib to E. Branch DuPage River		Not Assessed
Rott Creek		Not Assessed
Winfield Creek	*Habitat Alterations*, TDS	Not Assessed
Klein Creek	BOD, *Habitat Alterations*	Not Assessed
East Banch DuPage River	***D.O.***, *Habitat Alterations*, BOD, PAHs	DDT, **fecal coliform**, hexachlorobenzene, mercury, PCBs, **pH**, phosphorus (total), sedimentation & siltation, TSS
St. Joseph Creek	*Habitat Alterations*	Oil and grease, TSS

Study Area Setting

The Salt Creek watershed includes 152 square miles of highly urbanized land in western Cook and eastern DuPage Counties, including Addison Creek and Spring Brook, the two major tributaries (Figure 5). The main stem of Salt Creek is approximately 42 linear miles and has a rise of 225 feet. Salt Creek flows into the Des Plaines River in Lyons, which is tributary to the Illinois River and ultimately tributary to the Mississippi River. There are 40 municipalities located within the watershed and 11 publicly owned treatment plants discharge effluent to Salt Creek. Additionally, 6 combined sewer overflow outfalls are present. Land uses in the Salt Creek watershed are shown in Table 2.

The East Branch DuPage River watershed includes 81 square miles of central DuPage and northern Will Counties (Figure 6). The major tributaries are St. Josephs and Prentiss Creeks. The main stem of the East Branch is approximately 26 linear miles. The East Branch joins the West Branch of the DuPage River on the Bolingbrook municipal line to form the main stem of the DuPage River. The DuPage is a tributary to the Des Plains River. Sixteen municipalities are located within the watershed. A total of 11 publicly owned treatment plants discharge to the East Branch as does one combined sewer overflow. The land uses found in the East Branch watershed are mostly residential and urban (Table 2).

The West Branch DuPage River watershed includes 128 square miles of DuPage, Cook and northern Will Counties (Figure 7). The main stem of the West Branch measures 34 linear miles in length. There are 21 municipalities in the watershed and 7 publicly owned treatment plants discharge to the West Branch. There are no combined sewer overflows in the watershed. Like the East Branch and Salt Creek catchments, land uses in the West Branch are dominated by residential and urban uses (Table 2).

Table 2. Land uses types by area and percent for Salt Creek, and the East and West Branches of the DuPage River. Percentages based on total watershed area. Land use data is based on Chicago Metropolitan s Agency for Planning 2005 land use data.

Land Use Category	Salt Creek		East Branch		West Branch	
	area (acres)	area (percent)	area (acres)	area (percent)	area (acres)	area (percent)
Residential	48,657.50	49.9	27,899.10	53.6	36,082.40	44.2
Commercial and Services	10,824.80	11.1	4,732.00	9.1	6,199.90	7.6
Institutional	5,432.60	5.6	2,349.70	4.5	5,692.00	7.0
Industrial, Warehousing and Wholesale Trade	6,142.70	6.3	1,688.50	3.2	4,523.50	5.5
Transportation, Communication and Utilities	4,884.10	5.0	1,945.30	3.7	2,715.90	3.3
Sub Total non-Residential Urban	27,284.2	28.0	10715.5	20.5	19131.3	23.4
Agricultural Land	311.70	0.3	339.40	0.7	5,966.30	7.3
Open Space	16,426.20	16.8	10,370.40	19.9	13,661.90	16.7
Forest, Grassland and Wetlands greater than 2.5 acres	3,220.90	3.3	1,940.20	3.7	5,325.80	6.5
Water	1,670.00	1.7	761.00	1.5	1,524.40	1.9
Totals	97,570.50	100.0	52,025.60	100.0	81,692.10	100.0

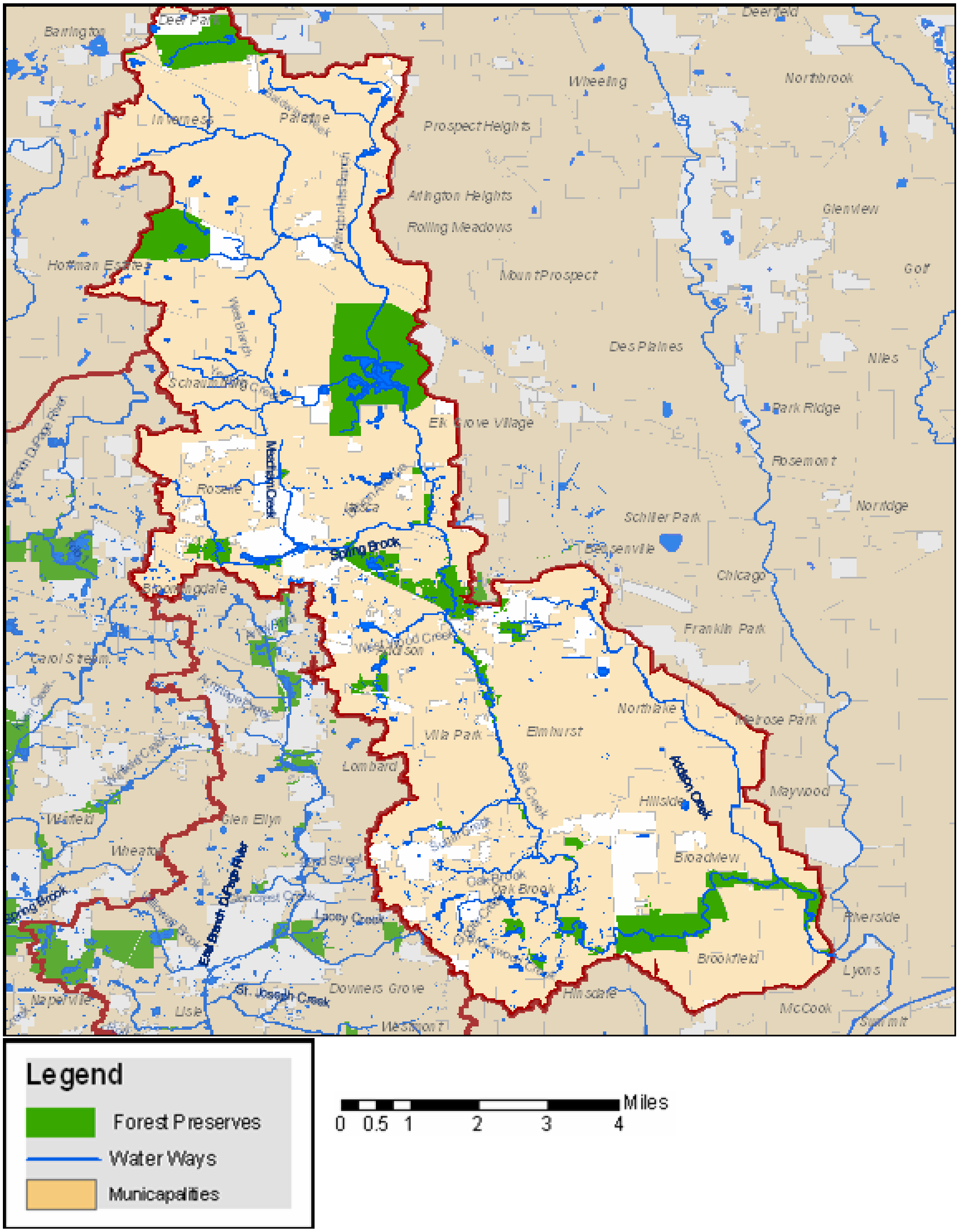


Figure 5. Municipal boundaries and forest preserves in the Salt Creek watershed.

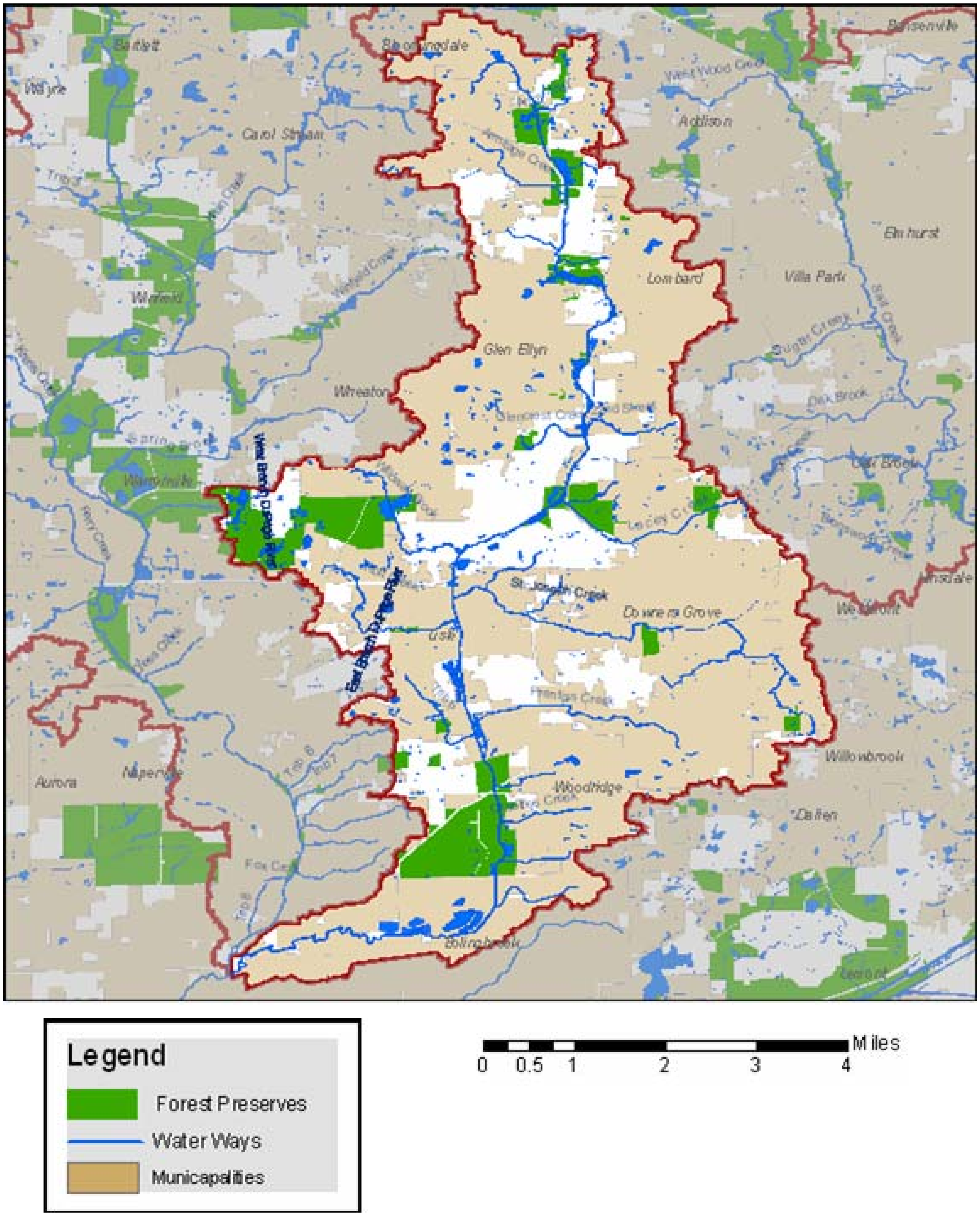


Figure 6. Municipal boundaries and forest preserves in the East Branch DuPage watershed.

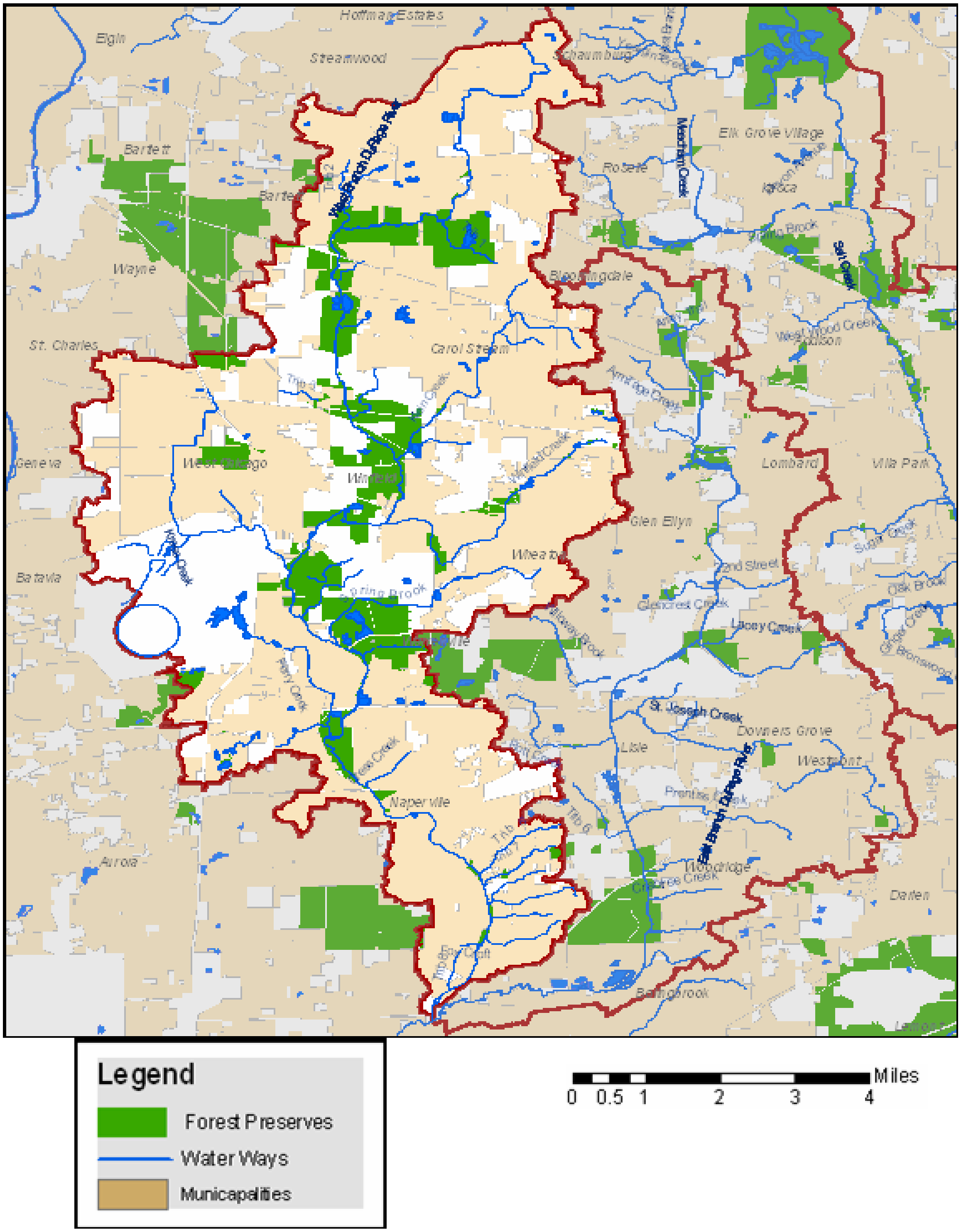


Figure 7. Municipal boundaries and forest preserves in the West Branch DuPage watershed.

Summary of Dams in the DuPage-Salt Creek River Study Area

Salt Creek (dams are ordered north to South)

Busse Woods Reservoir South Dam: The Busse Woods Reservoir South Dam is located on Salt Creek within the Busse Woods Forest Preserve. The dam is owned and maintained by the Illinois Department of Natural Resources Office of Water Resources and is located within Elk Grove Village. Access is best granted off of Arlington Heights Road to picnic groves 26 and 27 or 32.

The dam was built for flood control and recreational purposes in 1977. The dam is of earthen construction and has a height of 23 feet and is 1381 feet long. The reservoir has a surface area of 415 acres.

Section of the Busse Woods Impoundment, looking upstream from spillway

Itasca Country Club Dam: Situated on Spring Brook 50 feet upstream of Prospect Avenue. Dam privately owned and maintained. No other information gathered at this time.

Lake Kadijah Dam: Medinah Country Club, ½ mile upstream of Rohlwing Road/Route 53. Managed by DuPage County Division of Stormwater Management, no other information gathered at this time.

Oak Meadows Golf Course Dam: The Oak Meadows Golf Course dam is located on Salt Creek within the Oak Meadows Golf Course. The golf course is maintained by the Forest Preserve District of DuPage County and is located east of Addison Road and north of I-290. The date of construction is unknown. The dam is on hole 14.

The dam was built by Elmhurst Country Club to provide a source of irrigation water for the golf course. The spillway is approximately 3 feet high and is 75 feet wide. The impoundment is approximately 4, 500 linear feet in length and covers approximately six acres.

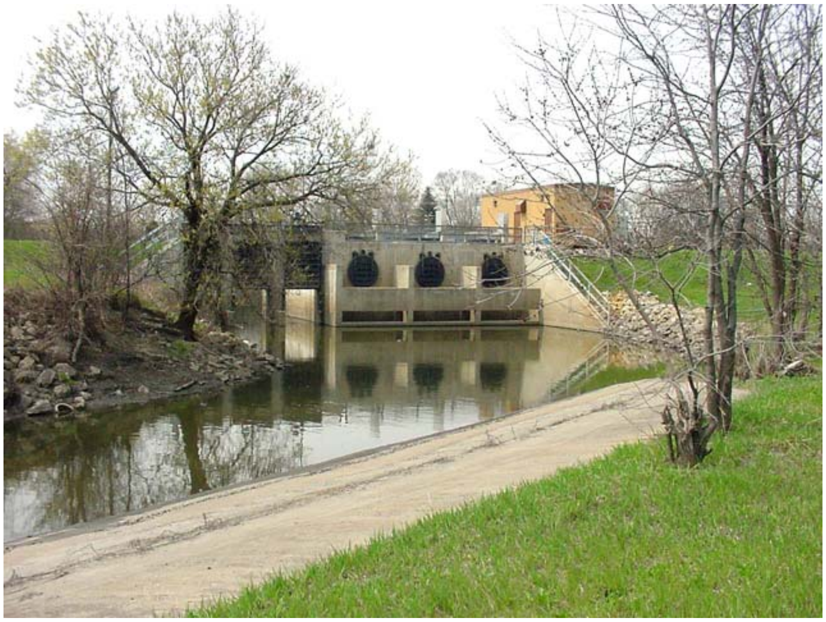
Table 3. Known dams or bed control structures in program watersheds. Sites listed as having impoundments size N/A (not applicable) are stormwater control structures and do not contain significant impoundments under non-storm conditions. Those listed as Un (unknown) means that it has not be ascertained if they impound waters to any significant degree and will require further investigation. Letters next to dam names correspond to those in Figures 11, 61, and 103 for the respective watersheds.

Dam Name	Watershed	Affected waterway	River Miles	Impoundment Size (acres)	Impedes Fish Passage
a) Busse Woods Reservoir South Dam	Salt Creek	Salt Creek	29.3	415	
b) Itasca Country Club dam	Salt Creek	Spring Brook	0.3	1	
c) Lake Kadijah	Salt Creek	Spring Brook	3.0	39	
d) Oak Meadows Golf Course Dam	Salt Creek	Salt Creek	22.8	6	Y
e) Westwood Creek Dam	Salt Creek	Westwood Creek	0.3	Un	
k) Redmond Reservoir Dam (George Street Dam)	Salt Creek	Addison Creek	10.0	13	
j) Mt Emblem Cemetery	Salt Creek	Addison Creek	8.7	3	
f) Graham Center Dam	Salt Creek	Salt Creek	16.5	Un	
g) Old Oak Brook dam	Salt Creek	Salt Creek	12.5	Un	??
h) Fullersburg Woods Dam picture	Salt Creek	Salt Creek	10.7	16	Y
i) Possom Hollow Woods	Salt Creek	Salt Creek	6.0	Un	
a) West Lake Dam	East Branch	East Branch	23.8	13	
d) Churchill Woods dam	East Branch	East Branch	18.7	31	Y
e) Maryknoll Gabion Weir Dam	East Branch	East Branch	16.8	None	N
f) Seven Bridges Dam	East Branch	East Branch	9.4	Un	
g) Prentiss Creek dam	East Branch	Prentiss Creek/East Branch	8.6/0.1	N/A	N
a)Warrenville Grove dam	West Branch	West Branch	38.89	17	Y
b) MacDowell Grove dam	West Branch	West Branch	36.55	8	Y
c) Fawell dam	West Branch	West Branch	8.0	N/A	Y


Oak Meadows Dam in Addison

Westwood Creek Dam (Salt Creek Trib. WWTP dam): The Westwood Creek dam is located on Westwood Creek, a tributary to Salt Creek in Addison. The dam is approximately 500 feet east of Addison Road and 200 feet southwest of I-290 and is maintained by the Village of Addison. Access to the dam is best gained from a driveway off of Addison Road, south of I-290.

The dam was put on line in 1994 as part of an effort by the DuPage County Stormwater Management Division to reduce flooding in the area. Residential areas to the west along Westwood Creek are protected during flood events by closing the gates of the dam and pumping Westwood Creek to Louis' Reservoir, a two stage 210 foot retention and detention area at the southwest corner of Lake Street and Villa Avenue.



Westwood Creek Dam in Addison

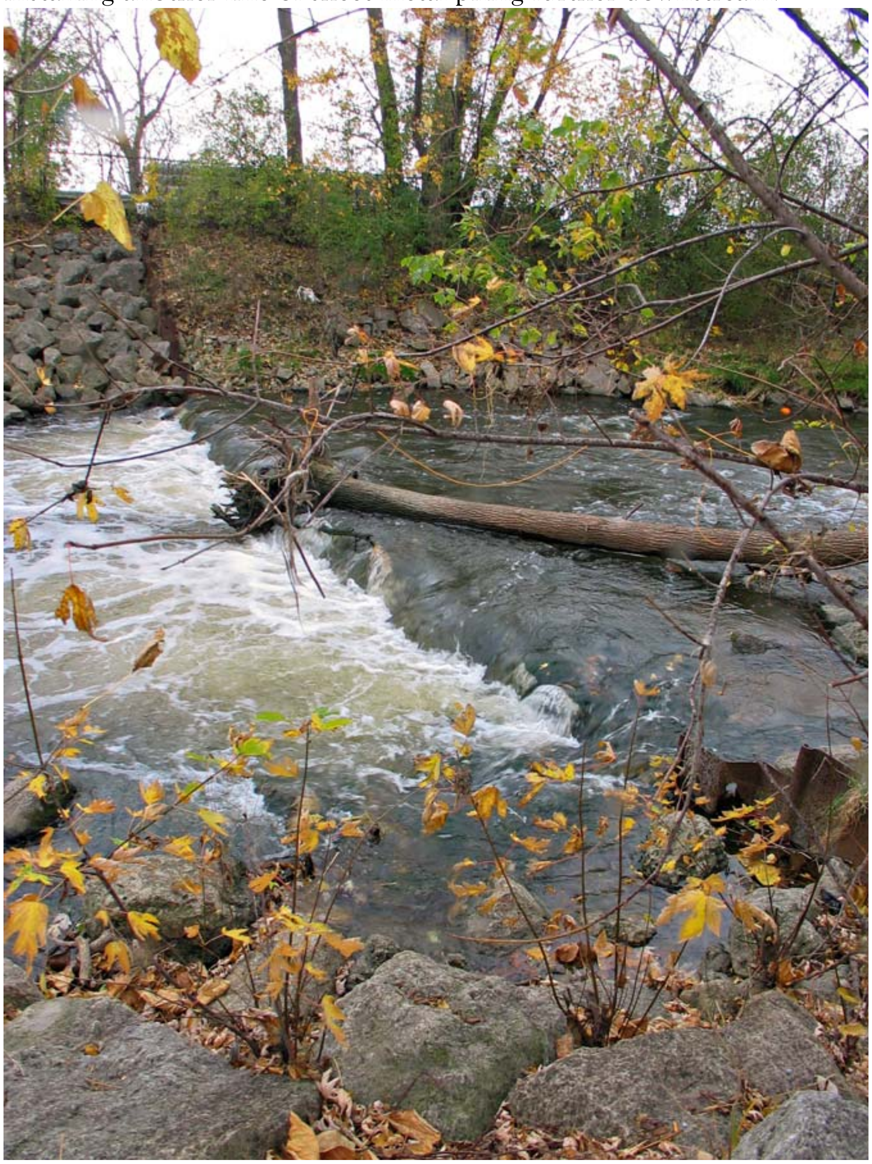
Redmond Reservoir Dam (George Street Reservoir): Addison Creek in Bensenville. Operated by the Village of Bensenville. Constructed in 1999. Headwaters originate in Wood Dale and Bensenville. http://dnr.state.il.us/OWR/Williamredmond.htm

Redmond Reservoir Dam in Bensenville

Mt Emblem Cemetery Pond: in Bensenville. Southwest corner of Grand Avenue and County Line Road

Graham Center Dam (Elmhurst Co. Forest Preserve Dam) The dam is located on Salt Creek near Elmhurst. The dam is ¼ mile east of Route 83 and ¼ mile south of Monroe Street. Access is best granted from Monroe Street on the west side of Salt Creek.

The dam was constructed in the early 1990's as a result of dredging on Salt Creek from Oak Brook north to this point. The structure was installed to allow for a step down between the dredged and undredged portions of the river and to prevent sedimentation of the dredged portions. The structure was not intended to be a dam, but in low flow conditions acts as one. The dam originally consisted of a single line of sheet metal piling. However, the creek began to erode the banks at the point of contact with the sheet metal piling. This was repaired by cutting a notch in the original sheet metal piling and installing another line of sheet metal piling further downstream.


Graham Center Dam in Elmhurst

Old Oak Brook Dam: The Old Oak Brook dam is located on Salt Creek, downstream of 31st Street in Oak Brook. The dam is maintained by the Village of Oak Brook and is approximately 85 years old. Access to the dam is best gained from Natoma Drive with permission of landowner (on private land).

The dam was originally built by Paul Butler in the 1920's to maintain an aesthetic pool on his property during low flow periods. The original structure of the Oak Brook Dam has undergone major rehabilitation over the last 20 years. There are two main spillway components: the fixed elevation spillway and a gated "emergency" spillway. The gated spillway section consists of two steel vertical slide gates. The dam was rehabilitated in 1992. The primary spillway is sixty-five feet wide, with about three feet of head at normal flow conditions, and consists of grouted stone with a concrete cap. The left and right training walls consist of grouted stone and reinforced concrete, overlain to a larger extent by concrete filled fabriform mats.

Old Oak Brook Dam

Fullersburg Woods Dam: The Fullersburg Woods Dam is located on Salt Creek associated with Graue Mill and within the Fullersburg Woods Forest Preserve. The dam is 300 feet upstream of York Road near the Village of Oak Brook. The dam is owned by the Forest Preserve District of DuPage County (FPDDC) and is 74 years old. Access to the dam is best granted from a trail and parking lot off of Spring Road.

The adjacent historic mill was originally constructed in 1852. The mill and dam were rebuilt by the Civilian Conservation Corps in the 1934. The dam is 123 feet across and 6.3 feet high. The impoundment created by the dam covers 16 acres and 3,900 linear feet.

Fullersburg Woods Dam, Village of Oak Brook

Possom Hollow Woods: in Westchester 0.5 miles east of Wolf Road, ¼ mile north of 31st Street FPDCC. No additional data collected at this time.

East Branch

West Lake Dam: Bloomingdale, West Lake Park, ½ mile north of Army Trail Road, 500 feet west of Glen Ellyn Road

Churchill Woods Dam: The Churchill Woods Dam is located on the East Branch of the DuPage River within the Churchill Woods Forest Preserve in Lombard. The dam is immediately upstream of Crescent Boulevard. The low head dam is owned by the Forest Preserve District of DuPage County (FPDDC) and is approximately 70 years old. Access to the dam is best granted from the Forest Preserve Parking Lot on Crescent Boulevard.

The dam was originally built in the 1930's as part of the Works Progress Administration. It was rebuilt with the reconstruction of Crescent Boulevard in 1983. The dam is a concrete gravity dam with a dewatering gate on the right side. The dam is 50 feet across and has a total height of 3.5 feet.

The impoundment created by the dam is approximately 31 acres in size.

Maryknoll Gabion Weir Dam: The Maryknoll gabion weir dam is located on the East Branch of the DuPage River, adjacent to the Maryknoll residential subdivision in Glen Ellyn. The dam is located east of Maryknoll Circle, approximately ¼ mile south of Route 38, and 200 feet west of I-355. Access to the dam is best granted from Maryknoll Circle.

The dam was constructed in the early 1980's as part of Maryknoll Development in order to provide stormwater detention for the development. Flow at normal water level is not impeded. The dam consists of gabions with no concrete caps. The impoundment does not extend further upstream than Route 38.

Seven Bridges Dam: Located in the Village of Woodridge

Prentiss Creek Dam: The Prentiss Creek Dam is located on the East Branch of the DuPage River within the Seven Bridges Golf Club in Woodridge. The dam actually consists of two structures, one on the East Branch and one at the mouth of Prentiss Creek, both located immediately upstream of Hobson Road. The structures are owned by the Village of Woodridge and are 19 years old. Access to the dams is best granted from the golf course, although it is possible to access the dam from Double Eagle Drive using the sidewalk.

The dam was constructed in 1989 to provide on line stormwater detention for the adjacent development. The dams are gravity structures consisting of rock filled gabions that impound water at a greater rate as the flow rate increases. The East Branch structure is 20 feet wide while the Prentiss Creek structure is 10 feet wide.

The dam creates a minor impoundment only on Prentiss Creek depending on flow conditions (storm control structure).

__West Branch__

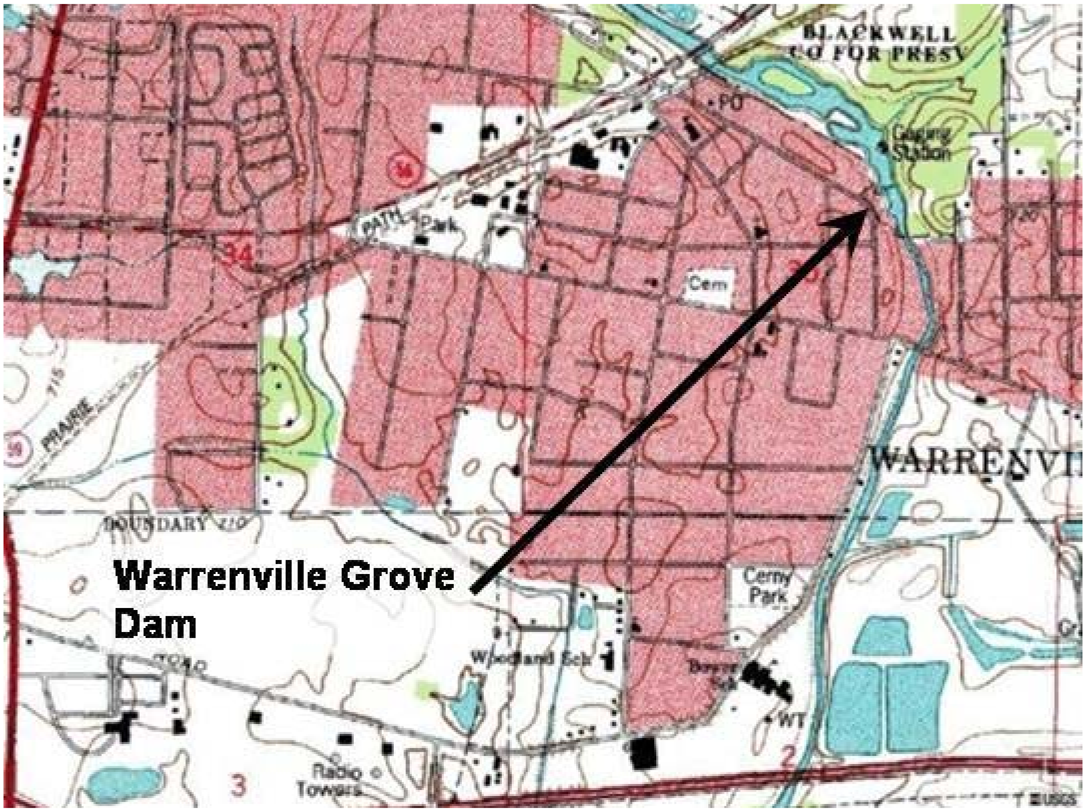
Warrenville Grove Dam: The Warrenville Grove Dam is located on the West Branch of the DuPage River within the Warrenville Grove Forest Preserve in the Village of Warrenville. The dam is one third of a mile upstream of Warrenville Road. The low head dam is owned by the Forest Preserve District of DuPage County (FPDDC) and is approximately 70 years old. Access to the dam is best grained via the Forest Preserve Parking Lot on Batavia Avenue.

The dam was constructed of limestone in a stair step configuration with a concrete foundation and headwall on the upstream face of the spillway. The dam is 107 feet across with a curving spillway face that has a total crest length of about 125 feet. The dam has a total height of 8.5 feet above the downstream river channel bottom and a total hydraulic height of 5.7 feet (from spillway crest to tailwater elevation under average flow conditions).

The dam also features a mill race that was partially retrofitted in 1995 to function as a fish ladder and canoe chute. The impoundment created by the Warrenville Grove Dam is approximately 1.2 miles in length and covers about 16.9 acres.

The dam was constructed by the Civilian Conservation Corps between 1936 and 1938. The dam was designed by the National Park Service and was part of a dam building program in the region that was conveyed as a way to "reduce bank erosion". The site for the dam was chosen due to the presence of an older abandoned dam in the same location that provided a power source to mills between 1847 and 1897.

Aerial view of the Warrenville Dam looking upstream (2001). Dam highlighted by arrow.



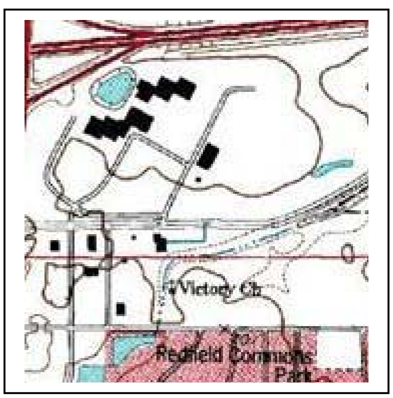
Map of Warrenville Grove Dam.

McDowell Grove Dam: The McDowell Grove Dam is located on the West Branch of the DuPage River within the McDowell Grove Forest Preserve in unincorporated DuPage County. The dam is one mile downstream of Interstate 88. The low head dam was built by the Civilian Conservation Corps and is approximately 70 years old. Access to the dam is best granted from the Forest Preserve Parking Lot located within McDowell Grove Forest Preserve.

The dam is constructed of limestone and is a run of the river structure. The stone spillway is likely cemented into place and supported by a reinforced concrete foundation and retaining wall on the upstream face. The dam has a concrete and stone fish ladder integrated into the spillway where it meets the left abutment. The dam is 96 feet across. The dam has a total height of 8.5 feet above the downstream river channel bottom and a total hydraulic height of 5.7 feet (from spillway crest to tailwater elevation under average flow conditions).

The impoundment created by the dam is approximately 2900 feet long and covers an area of 8 acres. Dam removed mid 2008 although impoundment remains due the to the installation of a temporary dam.

Aerial view of McDowell Grove Dam, looking upstream (2001). Dam highlighted by arrow.



Map of McDowell Grove Dam.

Fawell Dam One mile below McDowell Grove dam in McDowell Woods Forest Preserve. Large earthen berm with a floodgate. Stormwater control facility run by DuPage County Division of Stormwater management .

Methods

The collection of ambient biological, chemical, and physical data in the DuPage River-Salt Creek study area was conducted under a quality assurance project plan (QAPP; MBI 2006b) approved by Illinois EPA. Biological data was collected in accordance with methods adopted by the Illinois EPA and Illinois DNR whenever feasible. In cases where these methods were not applicable alternate methods used by MBI elsewhere in the Midwest were employed. Habitat was assessed using the Qualitative Habitat Evaluation Index (QHEI) by the fish sampling crew. Chemical/physical sampling was conducted by collecting multiple grab samples from the same sites and recording field measurements with water quality meters. Dissolved oxygen was recorded continuously over multiday periods using continuous recording devices.

Biological Methods: Macroinvertebrate Assemblage
The macroinvertebrate assemblage was sampled using the Illinois EPA multihabitat method at all level 1-5 sites. The MAIS (Macroinvertebrate Aggregated Index for Streams) method adapted for application to Illinois streams was used where the multihabitat method was either not applicable or feasible, mostly at the level 6 and 7 sites. Artificial substrates were used at a few non-wadeable sites in the lower mainstems using modified Hester-Dendy (H-D) artificial substrate samplers (Ohio EPA 1989).

The Illinois EPA multi-habitat method involves the selection of a sampling reach that has instream and riparian habitat conditions typical of the assessment reach, has flow conditions that approximate typical summer base flow, has no highly influential tributary streams, contains one riffle/pool sequence or analog (i.e., run/bend meander or alternate point-bar sequence), if present, and is at least 300 feet in length. This method is applicable if conditions allow the sampler to collect macroinvertebrates (i.e., to take samples with a dip net) in all bottom-zone and bank-zone habitat types that occur in a sampling reach. The habitat types are defined explicitly in Appendix E of the project QAPP (MBI 2006b). Conditions must also allow the sampler to apply the 11-transect habitat-sampling method, as described Appendix E of the Quality Assurance Project Plan (http://www.drscw.org/reports/DuPage.QAPP_AppendixE.07.03.2006.pdf) or to estimate with reasonable accuracy--via visual or tactile cues the amount of each of several bottom-zone and bank-zone habitat types. If conditions (e.g., inaccessibility, water turbidity, or excessive water depths) prohibit the sampler from estimating with reasonable accuracy the composition of the bottom zone or bank zone throughout the entire sampling reach, then the multi-habitat method is not applicable. In most cases, if more than one-half of the wetted stream channel cannot be seen, touched, or otherwise reliably characterized by the sampler, it is unlikely that reasonably accurate estimates of the bottom-zone and bank-zone habitat types are attainable; thus, the multi-habitat method is not applicable. The resulting samples were preserved in 10% formalin.

The MAIS method was used in lieu of the IEPA Multi-habitat Method where small channel size precluded its use primarily at the level 6 and 7 sites. MAIS samples are collected with a 1 m^2 fiber glass screened 500 micron kick net by sampling available riffle and run habitats at each site. The macroinvertebrates and debris are washed into a storage container after each consecutive kick composited into a single sample. The sample is strained through a number 30 (600 micron mesh) standard sieve; large debris is washed and scrubbed into the container and then discarded. The entire sample including debris was placed into jars and preserved with 10% formalin.

Artificial substrate samples were collected using modified Hester-Dendy (H-D) samplers (Ohio EPA 1989). An H-D consists of a series of 8 hardboard plates (1/8" thickness) and 12 spacers. The plates and spacers are center drilled and mounted to a 4-in.-long eye bolt and secured by a nut and washer. A "set" consists of five H-D samplers attached to a single concrete block. Samplers are placed in the stream for colonization during June 15 to September 30 (the latest date for retrieval under normal circumstances). Ohio EPA (1989) describes details of placement of the samplers to ensure adequate stream flow over the plates, but in general samplers should be set where flow is 0.3 ft/sec over the plates. The H-D set is retrieved and preserved in 10 percent formalin as individual units and later combined to form a composite sample. A qualitative sample from the natural substrate is also collected at the time of substrate retrieval using a triangular frame 30-mesh dip net. All available habitats are sampled at a given site for a minimum time of 30 minutes and thereafter until no new taxa are observed. This generally includes 20+ jabs taken from all available habitats in the sampling area including snags, wood, submerged vegetation, vegetated banks, root wads, and riffles.

Laboratory procedures generally followed Illinois EPA methods. For the multi-habitat method this required the production of a 300 organism subsample with a scan and pre-pick of large and/or rare taxa from a gridded tray. For artificial substrates the laboratory processing includes the production of a sample by the disassembly and cleaning of the artificial substrates and subsampling procedures as followed by Illinois EPA. The MAIS and qualitative dip net/hand pick samples did not require initial laboratory reduction. Taxonomic resolution was performed at the lowest practicable resolution for the common macroinvertebrate assemblage groups such as mayflies, stoneflies, caddisflies, midges, and crustaceans. This goes beyond the genus level requirement of Illinois EPA; however, calculation of the macroinvertebrate IBI followed Illinois EPA methods in using genera as the lowest level of taxonomy for MIBI scoring.

Biological Methods: Fish Assemblage

Methods for the collection of fish at wadeable sites was performed using a tow-barge or long-line pulsed D.C. electrofishing equipment based on a T&J 1736 DCV electrofishing unit described by Ohio EPA (1989). A Wisconsin DNR battery powered backpack electrofishing unit was used as an alternative to the long line in the smallest streams and in accordance with the restrictions described by Ohio EPA (1989). A three person crew carried out the sampling protocol for each type of wading equipment. Sampling effort was indexed to lineal distance and ranged from 150-200 meters in length. Non-wadeable sites were sampled with a boat-mounted pulsed D.C. electrofishing device. A Smith-Root 5.0 GPP unit was mounted on a 12' john boat following the design of Ohio EPA (1989). Sampling effort for this method was 500 meters. A summary of the key aspects of each method appears the project QAPP (MBI 2006b). Sampling distance was measured with a GPS unit or laser range finder. Sampling locations were delineated using the GPS mechanism and indexed to latitude/longitude and UTM coordinates at the beginning, end, and mid-point of each site. The location of each sampling site was indexed by river mile (using river mile zero as the mouth of the river). Sampling was conducted during a June 15-October 15 seasonal index period.

Samples from each site were processed by enumerating and recording weights by species and in some cases by life stage (y-o-y, juvenile, adult). All captured fish were immediately placed in a live well, bucket, or live net for processing. Water was replaced and/or aerated regularly to maintain adequate dissolved oxygen levels in the water and to minimize mortality. Fish not retained for voucher or other purposes were released back into the water after they had been identified to species, examined for external anomalies, and weighed. Weights were recorded at level 1-5 sites only. Larval fish were not included in the data and fish measuring less than 15-20 mm in length were generally not included in the data as a matter of practice. The incidence of external anomalies was recorded following procedures outlined by Ohio EPA (1989) and refinements made by Sanders et al. (1999). While the majority of captured fish were identified to species in the field, any uncertainty about the field identification of individual fish required their preservation for later laboratory identification. Fish were preserved for future identification in borax buffered 10% formalin and labeled by date, river or stream, and geographic identifier (e.g., river mile). Identification was made to the species level at a minimum and to the sub-specific level if necessary. A number of regional ichthyology keys were used and included the Fishes of Illinois (Smith 1979) and updates available through the Illinois Natural History Survey (INHS). Vouchers were deposited and verified at The Ohio State University Museum of Biodiversity (OSUMB).

Habitat Assessment

Physical habitat was evaluated using the Qualitative Habitat Evaluation Index (QHEI) developed by the Ohio EPA for streams and rivers in Ohio (Rankin 1989, 1995). Various attributes of the habitat are scored based on the overall importance of each to the maintenance of viable, diverse, and functional aquatic faunas. The type(s) and quality of substrates, amount and quality of instream cover, channel morphology, extent and quality of riparian vegetation, pool, run, and riffle development and quality, and gradient are some of the metrics used to determine the QHEI score which generally ranges from 20 to less than 100. The QHEI is used to evaluate the characteristics of a stream segment, as opposed to the characteristics of a single sampling site. As such, individual sites may have poorer physical habitat due to a localized disturbance yet still support aquatic communities closely resembling those sampled at adjacent sites with better habitat, provided water quality conditions are similar. QHEI scores from hundreds of segments around the state have indicated that values greater than 60 are *generally* conducive to the existence of warmwater faunas whereas scores less than 45 generally cannot support a warmwater assemblage consistent with baseline Clean Water Act goal expectations (e.g., the General Use in the Illinois WQS). Scores greater than 75 frequently typify habitat conditions which have the ability to support an exceptional warmwater fish assemblage.

Data Management and Analysis

MBI employed the data storage, retrieval, and calculation routines available in the Ohio ECOS system as described in the project QAPP (MBI 2006b). Fish and macroinvertebrate data were reduced to standard relative abundance and species/taxa richness and composition metrics. The

Illinois Index of Biotic Integrity (IBI) was calculated with the fish data. The macroinvertebrate data were analyzed using the Illinois Macroinvertebrate Index of Biotic Integrity (MIBI).

Determination of Causal Associations
Using the results, conclusions, and recommendations of this report requires an understanding of the methodology used to determine biological status (i.e., unimpaired or impaired, narrative ratings of quality) and assigning associated causes and sources of impairment. The identification of impairment in rivers and streams is straightforward - the numerical biological indices are the principal arbiter of aquatic life use attainment and impairment following the guidelines of Illinois EPA. The rationale for using the biological results in the role of principal arbiter within a weight of evidence framework has been extensively discussed elsewhere (Karr *et al.* 1986; Karr 1991; Ohio EPA 1987a,b; Yoder 1989; Miner and Borton 1991; Yoder 1991; Yoder 1995).

Describing the causes and sources associated with observed impairments relies on an interpretation of multiple lines of evidence including water chemistry data, sediment data, habitat data, effluent data, biomonitoring results, land use data, and biological response signatures (Yoder and Rankin 1995; Yoder and DeShon 2003). Thus the assignment of principally associated causes and sources of biological impairment in this report represents the association of impairments (based on response indicators) with stressor and exposure indicators using linkages to the biosurvey data based on previous experiences within the strata of analogous situations and impacts. The reliability of the identification of associated causes and sources is increased where many such prior associations have been observed. The process is similar to making a medical diagnosis in which a doctor relies on multiple lines of evidence concerning patient health. Such diagnoses are based on previous research which experimentally or statistically links symptoms and test results to specific diseases or pathologies. Thus a doctor relies on previous experiences in interpreting symptoms (*i.e.*, multiple lines from test results) to establish a diagnosis, potential causes and/or sources of the malady, a prognosis, and a strategy for alleviating the symptoms of the disease or condition. As in medical science, where the ultimate arbiter of success is the eventual recovery and well-being of the patient, the ultimate measure of success in water resource management is the restoration of lost or damaged ecosystem attributes including assemblage structure and function.

Hierarchy of Water Indicators
A carefully conceived ambient monitoring approach, using cost-effective indicators comprised of ecological, chemical, and toxicological measures, can ensure that all relevant pollution sources are judged objectively on the basis of environmental results. A tiered approach that links the results of administrative actions with true environmental measures was employed by our analyses. This integrated approach is outlined in Figure 8 and includes a hierarchical continuum from administrative to true environmental indicators. The six “levels” of indicators include:

1) actions taken by regulatory agencies (permitting, enforcement, grants);
2) responses by the regulated community (treatment works, pollution prevention);
3) changes in discharged quantities (pollutant loadings);
4) changes in ambient conditions (water quality, habitat);

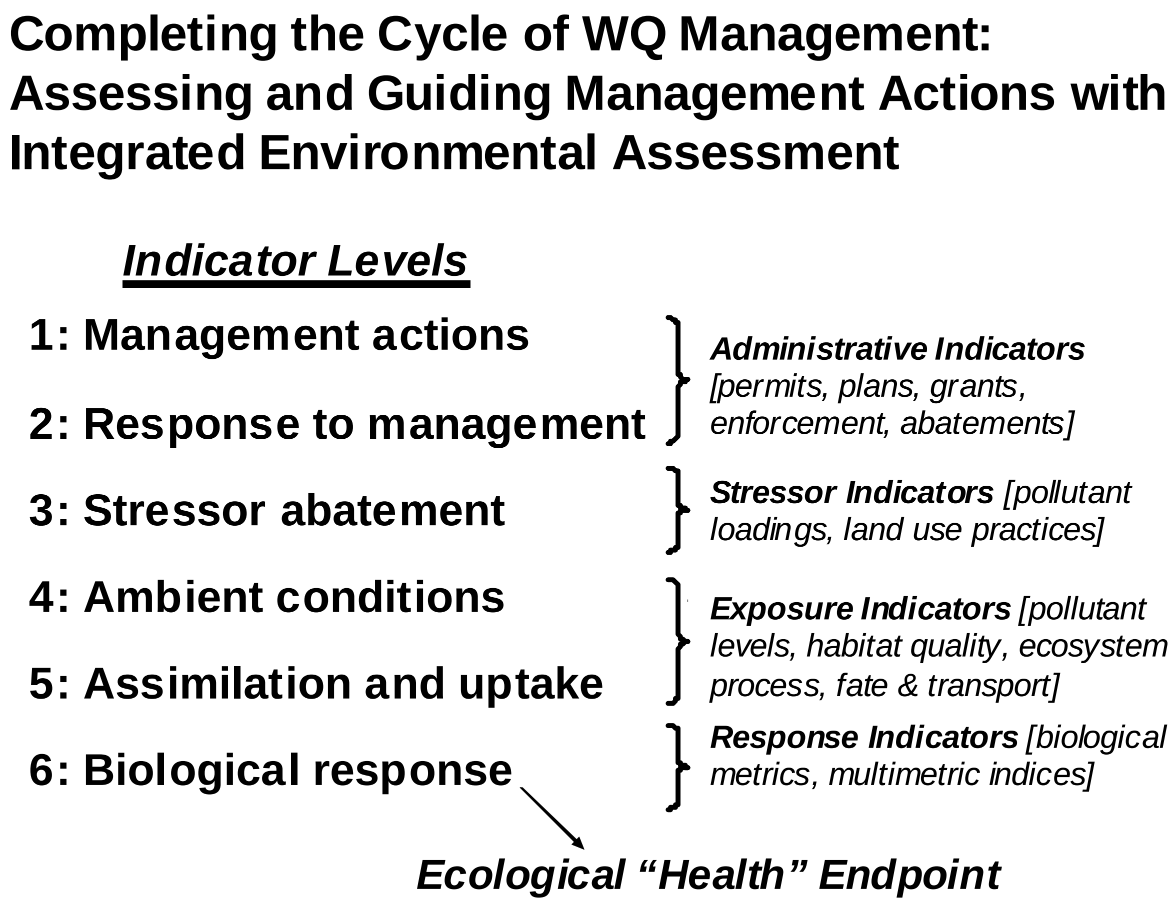


Figure 8. Hierarchy of administrative and environmental indicators which can be used for water quality management activities such as monitoring and assessment, reporting, and the evaluation of overall program effectiveness. This is patterned after a model developed by U.S. EPA (1995) and further enhanced by Karr and Yoder (2004).

5) changes in uptake and/or assimilation (tissue contamination, biomarkers, assimilative capacity); and,
6) changes in health, ecology, or other effects (ecological condition, pathogens).

In this process the results of administrative activities (levels 1 and 2) can be linked to efforts to improve water quality (levels 3, 4, and 5) which should translate into the environmental "results" (level 6). An example is the aggregate effect of billions of dollars spent on water pollution control since the early 1970s that have been determined with quantifiable measures of environmental condition (Yoder et al. 2005). Superimposed on this hierarchy is the concept of stressor, exposure, and response indicators. *Stressor* indicators generally include activities which have the potential to degrade the aquatic environment such as pollutant discharges (permitted and unpermitted), land use effects, and habitat modifications. *Exposure* indicators are those which measure the effects of stressors and can include whole effluent toxicity tests, tissue residues, and biomarkers, each of which provides evidence of biological exposure to a stressor or bioaccumulative agent. *Response* indicators are generally composite measures of the cumulative effects of stress and exposure and include the more direct measures of community and population response that are represented here by the biological indices which comprise the Illinois EPA biological endpoints. Other response indicators can include target assemblages, *i.e.,* rare, threatened, endangered, special status, and declining species or bacterial levels that serve as surrogates for the recreational uses. These indicators represent the essential technical elements for watershed-based management approaches. The key, however, is to use the different indicators *within* the roles which are most appropriate for each (Yoder and Rankin 1998).

Determining Causal Associations

Describing the causes and sources associated with observed impairments revealed by the biological criteria and linking this with pollution sources involves an interpretation of multiple lines of evidence including water chemistry data, sediment data, habitat data, effluent data, biomonitoring results, land use data, and biological response signatures within the biological data itself. Thus the assignment of principal causes and sources of impairment represents the association of impairments (defined by response indicators) with stressor and exposure indicators. The principal reporting venue for this process on a watershed or subbasin scale is a biological and water quality report. These reports then provide the foundation for aggregated assessments such as the Illinois Water Resource Inventory (305[b] report), the Illinois Nonpoint Source Assessment, and other technical products.

Illinois Water Quality Standards: Designated Aquatic Life Uses

The Illinois Water Quality Standards (WQS; 303.204-206) consist of designated uses and chemical criteria designed to represent measurable properties of the environment that are consistent with the goals specified by each use designation. Use designations consist of two broad groups, aquatic life and non-aquatic life uses. Chemical, physical, and/or biological criteria are generally assigned to each use designation in accordance with the broad goals defined by each. The system of use designations employed in the Illinois WQS constitutes a general approach in that one or two levels of protection are provided and extended to all water bodies regardless of size or position in the landscape. In applications of state WQS to the management of water resource issues in rivers and streams, the aquatic life use criteria frequently result in the most stringent protection and restoration requirements, hence their emphasis in biological and water quality reports. Also, an emphasis on protecting for aquatic life generally results in water quality suitable for all uses.

Biological and Water Quality Results – Salt Creek

Water quality and biological communities within a given stream reach are influenced by the surrounding landscape, local physical stream habitat, the cumulative condition of physical habitat upstream from a given reach, hydrology, and pollution loadings. The Salt Creek watershed covers 152 square miles of highly urbanized land in western Cook and eastern DuPage Counties, and includes Addison Creek and Spring Brook, the two major tributaries. Salt Creek flows into the Des Plaines River in Lyons, which is tributary to the Illinois River and ultimately tributary to the Mississippi River. There are 40 municipalities located within the watershed, and 11 publicly owned treatment plants discharge to the watershed. Additionally, six combined sewer overflow outfalls are present.

The percentage of urban (28%) and residential land uses (49.9%) in the basin (Table 2) are high enough to be very important determinants of water and biological quality. Various studies have shown that once the amount of urban land use (as measured by impervious surfaces visible in satellite imagery, or aerial photography) in a watershed exceeds between 10 and 30 percent, the biological quality of its streams becomes compromised. This is because pollutants that build-up on roads and other surfaces are flushed to the streams at toxic levels during storms. Also, hardening of the watershed by building roads decreases infiltration, which leads to higher rates of runoff and less residual base flow. The higher rates of runoff, in turn, damage stream habitat, and lower base flows simply mean less water is available for aquatic life during the dry summer months, and for dilution.

The overarching effect of urban land use on the biological communities in Salt Creek is evident in biological communities uniformly scoring in the lower half of respective biological index quality ranges, and in no single score achieving the minimum needed to meet the basic Clean Water Act goal (Figure 9). Also telling in Figure 9 is the condition of the macroinvertebrate communities in the small headwaters, relative to that in larger size classes. Given that headwaters interface with the uplands, they bear the brunt of the first flush from an urban landscape. One needs to interpret the results of this study, and evaluate potential stressors against the background conditions imposed by a highly urbanized landscape. In that vein, Figure 10 compares the distributions of total dissolved solids (TDS) and ammonia-nitrogen (NH3) across stream size categories. All streams contain some amount of TDS, but concentrations above 700 mg/l are unusual, and those greater than 1000 mg/l are injurious to some forms of aquatic life, especially macroinvertebrates. The high levels of TDS measured in the smallest headwaters (Figure 10) coincide with low macroinvertebrate scores (Figure 9). Although source tracking was beyond the scope of this study, the TDS in the headwaters is apparently related to diffuse sources and not to point sources.

By contrast, concentrations of ammonia-nitrogen, a constituent of treated wastewater, showed no pattern across stream size classes (Figure 10). Unlike TDS, which is only toxic at very high concentrations, ammonia is highly toxic at very low concentrations. Ammonia is normally present in running waters in vanishingly small concentrations because it is readily oxidized to nitrate nitrogen. Wastewater treatment plants are, however, essentially in the business of managing carbonaceous and nitrogenous wastes, and so represent a source of nitrogen (and carbon) to receiving waters. Plants that are treating wastewater efficiently usually discharge effluent with an ammonia concentration less than 1.0 mg/l; a concentration that, under typical conditions, is tolerated by most fish and macroinvertebrates. Apart from two measurements, ammonia concentrations sampled in the Salt Creek watershed were all less than 1.0 mg/l, and signal that wastewater loadings were not a major determinant of biological quality. Table 4 lists the results of the biological survey for the Salt Creek watershed, and includes the fish and macroinvertebrate community scores, a habitat quality index score (the QHEI), and a narrative regarding whether the biological community at a site is meeting the basic standard for the Clean Water Act.

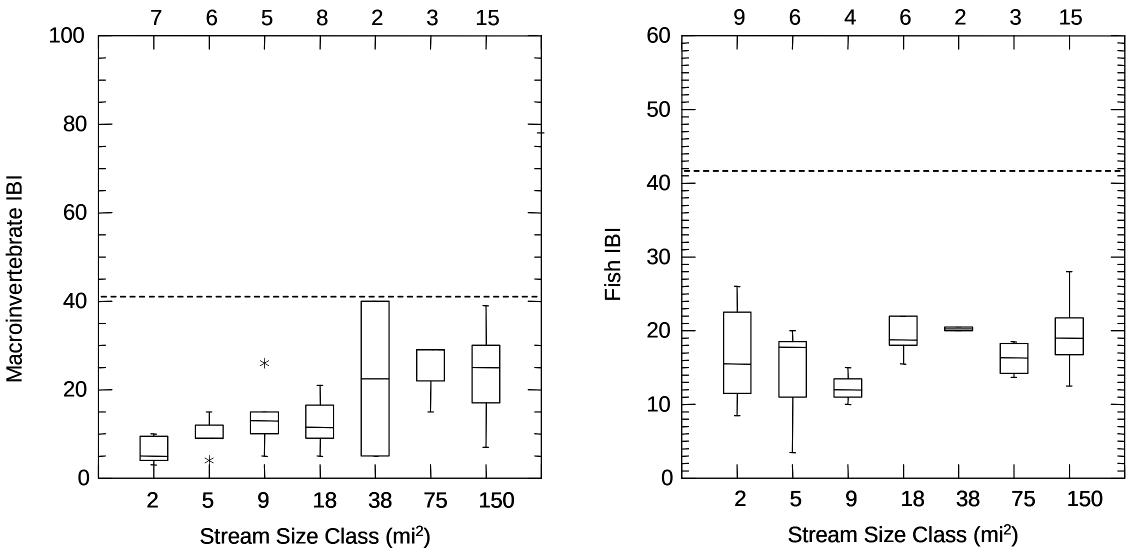


Figure 9. Distributions of macroinvertebrate and fish Index of Biotic Integrity (IBI) scores for sites sampled in 2007 from the Salt Creek basin. Results are stratified by drainage area. The dashed line in each plot shows the minimum score needed for the indicator to meet basic biological quality standards.

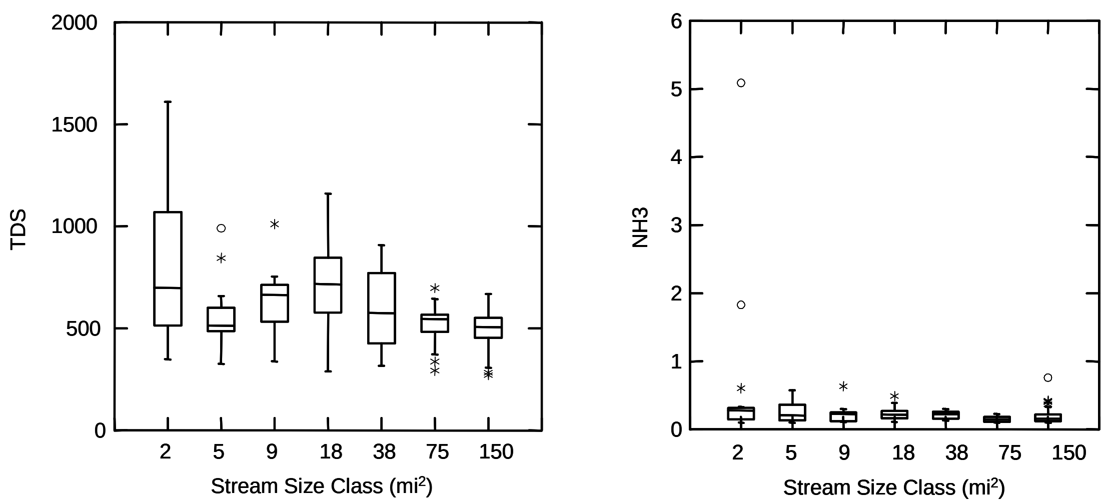


Figure 10. Concentrations (mg/l) of total dissolved solids (TDS) and ammonia-nitrogen (NH3) stratified by drainage area for sites sampled in the Salt Creek basin, 2007.

Table 4. Attainment status of sites sampled in the Salt Creek drainage, 2007. Status is based on the performance of both the macroinvertebrate IBI (MIBI) and fish IBI. The Qualitative Habitat Evaluation Index (QHEI) rates habitat quality on a scale of 12 to 100, and Modified Index of Well-being (MIWb) gauges fish abundance and diversity on a scale of 0 to 12. Attainment status based on only one indicator group is encased in parentheses.

River Mile	Site ID	QHEI	MIBI	Fish IBI	MIWb	IEPA Goal Attainment	Drain Area
95-840	Arlington Heights Branch Salt Creek						
4.00	SC06	30.5	5.0			Non	7.7
1.50	SC45	45.0	13.0			Non	10.0
0.25	SC08	57.5	12.0			Non	12.7
95-845	Baldwin Creek						
2.00	SC05	64.0	3.0	15.5		Non	2.0
95-850	Salt Creek						
39.50	SC04	43.5	13.0	15.0		Non	6.3
36.00	SC07	75.5	8.0	19.5		Non	16.0
32.00	SC15	44.0	40.0	20.0	8.5	Non	32.0
29.00	SC43	47.0	15.0	18.5	7.6	Non	60.0
27.00	SC42	67.5	29.0	18.0	6.4	Non	53.5
25.00	SC41	58.5	~	13.7	4.3	(Non)	70.0
24.50	SC40	63.5	29.0	14.7	4.4	Non	75.0
23.50	SC34	54.0	28.0	21.0	8.0	Non	76.0
23.00	SC35	46.5	20.0	19.0	7.1	Non	80.0
22.50	SC23	71.0	24.0	21.5	7.2	Non	84.0
20.50	SC39	74.0	36.0	23.0	6.6	Non	79.0
18.00	SC38	84.0	24.0	16.0	5.4	Non	87.0
17.50	SC37	76.5	25.0	15.5	5.1	Non	95.0
17.00	SC51	74.5	25.0	12.5	4.7	Non	95.0
16.50	SC57	71.5	27.0	14.0	5.4	Non	95.0
13.50	SC55	47.5	14.0	17.5	5.4	Non	102.0
12.50	SC56	40.5	8.0	18.5	6.0	Non	107.0
11.00	SC53	39.5	7.0	19.0	6.9	Non	110.0
10.50	SC52	82.5	33.0	28.0	8.9	Non	112.0
8.00	SC49	87.5	32.0	23.5	4.6	Non	114.0
3.00	SC54	79.0	39.0	22.0	6.0	Non	145.0
0.50	SC29	77.0	8.0	21.5	6.1	Non	150.0

Table 4. Continued.

River Mile	Site ID	QHEI	MIBI	Fish IBI	MIWb	CWA Goal Attainment	Drain Area
95-851	Trib to Salt Creek						
2.00	SC01	89.0	5.0	19.0		Non	1.1
95-852	Trib to Salt Creek						
0.25	SC02	71.5	10.0	22.5		Non	0.9
95-853	Trib to Salt Creek						
0.50	SC03	79.5	9.0	17.5		Non	2.5
95-855	Trib to Salt Creek						
4.00	SC11	44.5	15.0	18.5		Non	4.0
95-856	Trib to Salt Creek						
2.50	SC14	85.0	20.0	18.0		Non	10.0
95-857	Yeargin Creek						
0.25	SC12	49.0	5.0	15.0		Non	1.8
95-858	Ginger Creek						
1.50	SC30	61.5	15.0	10.0		Non	5.2
95-859	Sugar Creek						
0.25	SC33	62.5	12.0	20.0		Non	3.5
95-860	Addison Creek						
10.50	SC24	37.5	3.0	10.0		Non	2.0
8.00	SC26	45.0	9.0	3.5		Non	5.0
5.00	SC27	62.5	21.0	18.0		Non	10.0
2.50	SC48	52.5	5.0	15.5		Non	18.0
1.50	SC28	55.5	5.0	20.5		Non	20.0
95-861	Trib to Addison Creek						
0.50	SC25	51.5		8.5		Non	1.0
95-870	Spring Brook						
6.00	SC46	71.5	9.0	11.0		Non	3.5
4.50	SC18	38.0	26.0	12.0		Non	5.1
2.50	SC47	60.0	10.0	22.0		Non	10.0
0.25	SC16	44.5	11.0	22.0		Non	14.2
95-871	Meacham Creek						
0.35	SC17	56.5	10.0	12.0		Non	6.0

Table 4. Continued.

River Mile	Site ID	QHEI	MIBI	Fish IBI	MIWb	CWA Goal Attainment	Drain Area
95-875	Oakbrook Creek						
0.50	SC36	64.5		26.0		Non	0.8
0.25	SC32	67.5	10.0	24.5		Non	1.2
95-881	Trib to Meacham Creek						
0.25	SC20	85.5	9.0	11.5		Non	2.0
95-882	Westwood Creek						
0.50	SC22	61.0	4.0	18.0		Non	4.0

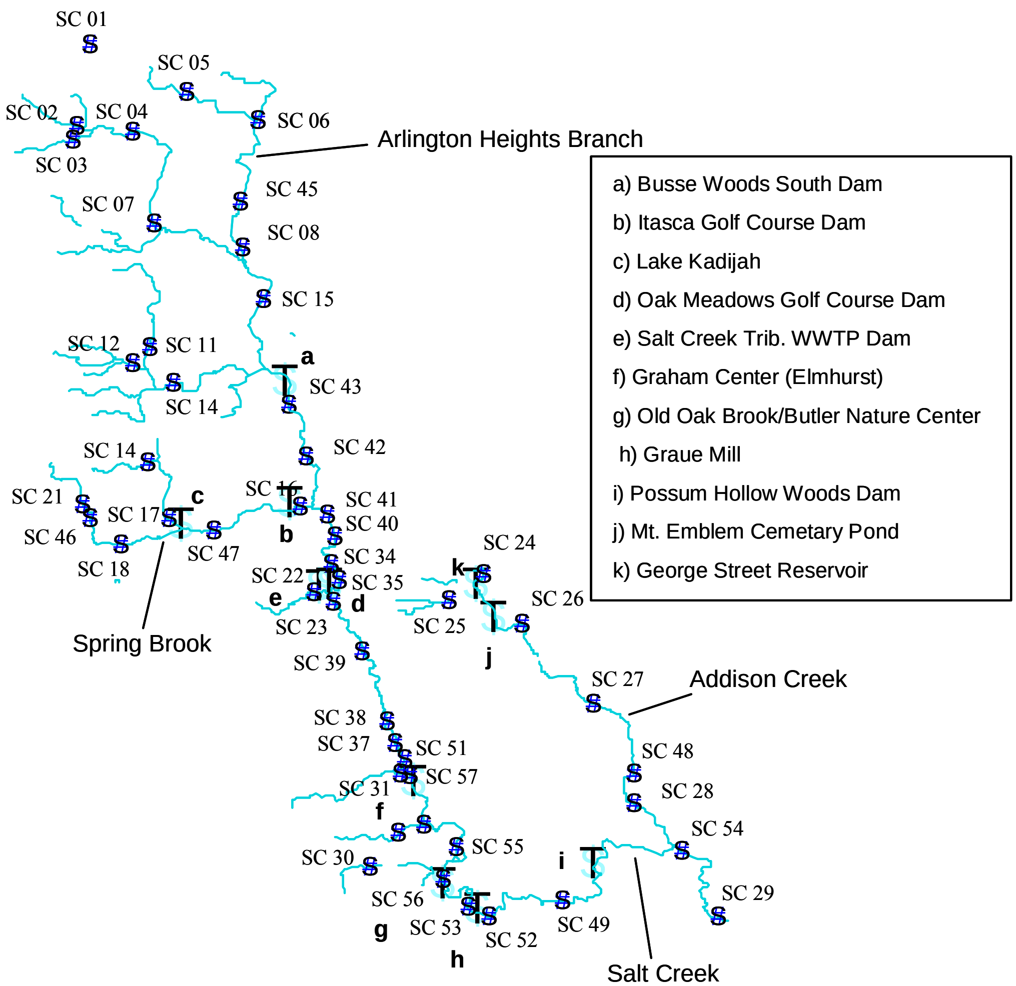


Figure 11. Locations of sites sampled in the Salt Creek drainage referenced in Table 4. For specific location information of each site, see Table 5. Locations of dams and their names (inset key) referenced in the text are noted on the figure as triangles.

Table 5. Site location table for the Salt Creek survey area (shown in Figure 11). River mile for a particular stream is measured as the distance upstream from its confluence with a receiving body. Samples are as follows: C, water chemistry; Co, water chemistry with a scan for organic pollutants; D, automated data logger for dissolved oxygen; F, fish community, M, benthic macroinvertebrate community; S, sediment chemistry.

Site ID	River Mile	Samples	Location or Landmark	Latitude	Longitude
95-840		Arlington Heights Branch of Salt Creek			
SC 06	4.00	C, F, M	Adj. to Maple Park, Palatine, Ill.	42.1145	-88.0137
SC 45	1.50	C, F, M, S	Ust Campbell St. @ Roger Florey Park	42.0841	-88.0991
SC 08	0.25	C, F, M	Ust Central Rd./adj. Opera In Focus bldg.	42.0669	-88.0189
95-845		Baldwin Creek			
SC 05	2.00	C, F, M	Ust foot bridge @ Carpenter Rd.	42.1252	-88.0395
95-850		Salt Creek			
SC 04	39.50	C, F, M	Corner of Palatine Rd. and Quentin Rd.	42.1106	-88.0600
SC 07	36.00	C, F, M	At end of Plum Grove Rd.	42.0763	-88.0525
SC 15	32.00	C, F, M, S	Dst Golf Rd. (SR 581)	42.0510	-88.0095
SC 43	29.00	Co, F, M	Dst Arlington Heights Ave at Elkgrove HS	42.0122	-88.0011
SC 42	27.00	C, F, M	Dst Devon Rd	41.9925	-87.9952
SC 41	25.00	Co, F, M, S	Dst MWRDGC retention facility ramp	41.9705	-87.9884
SC 40	24.50	Co, F, M	Dst Irving Park Rd.	41.9630	-87.9844
SC 34	23.50	Co, F, M	Dst Elizabeth Drive	41.9520	-87.9866
SC 35	23.00	Co, F, M	Ust Oak Meadows G.C. dam	41.9462	-87.9827
SC 23	22.50	C, F, M, S	Behind ball field off Stone Ave.	41.9384	-87.9858
SC 39	20.50	Co, F, M, S	Dst Fullerton Ave.	41.9201	-87.9730
SC 38	18.00	Co, F, M, S	Ust Charles Rd	41.8950	-87.9637
SC 37	17.50	Co, F, M	Between Salt Creek WWTP and Elmhurst WWTP	41.8852	-87.9600
SC 51	17.00	C, F, M	Dst Elmhurst WWTP/ Ust Graham Center Dam	41.8797	-87.9584
SC 57	16.50	C, D, F, M	Dst Graham Center Dam below Elmhurst WWTP	41.8742	-87.9560
SC 55	13.50	C, F, M	Dst 22nd St bridge	41.8475	-87.9365
SC 56	12.50	Co, F, M	Ust Oakbrook Rd/ Dst GC bridge	41.8356	-87.9423
SC 53	11.00	C, D, F, M, S	Dst Fullerton F.P. bridge/ entrance off Spring Rd	41.8254	-87.9316
SC 52	10.50	C, D, F, M, S	Dst York Rd	41.8206	-87.9266
SC 49	8.00	C, F, M, S	Dst Wolf Rd. bridge	41.8258	-87.9002
SC 54	3.00	C, F, M, S	Dst 17th Ave on Salt Creek F.P.	41.8456	-87.8521
SC 29	0.50	C, F, M, S	Ust SR 171 bridge and confluence w/ DesPlaines R.	41.8198	-87.8392

Table 5. Continued.

Site ID	River Mile	Samples	Location or Landmark	Latitude	Longitude
95-851		Trib to Salt Creek			
SC 01	2.00	C, F, M	Ust service road culvert in Deer Grove F.P.	42.1437	-88.0770
95-852		Trib to Salt Creek			
SC 02	0.25	C, F, M	Dst Inverway Dr. off Palatine Rd	42.1129	-88.0817
95-853		Trib to Salt Creek			
SC 03	0.50	C, F, M	Ust Plymouth St, culvert	42.1082	-88.0837
95-855		Trib to Salt Creek			
SC 11	5.00	C, F, M	Ust Schaumburg Rd/ Dst bike path	42.0300	-88.0550
95-856		Trib to Salt Creek			
SC 14	2.50	C, F, M	Dst Meacham Rd	42.0177	-88.0445
95-857		Yeargin Creek			
SC 12	0.25	C, F, M	Ust Palm Grove Rd.	42.0246	-88.0606
95-858		Ginger Creek			
SC 30	1.50	C, F, M	Dst MIdwest Rd. below first pond	41.8383	-87.9692
SC 31	0.55	C	Ust from Jorie Blvd	41.8394	-87.9532
95-859		Sugar Creek			
SC 33	0.25	C, F, M	Dst Riverside/ Dst SR 83	41.8732	-87.9574
95-860		Addison Creek			
SC 24	10.50	C, F, M	Ust Jefferson Rd	41.9464	-87.9264
SC 26	8.00	C, F, M	Adj. to park on Rhodes Ave./ S. of Grand	41.9287	-87.9106
SC 27	5.00	C, F, M	Ust SR 45 @ PlayPen	41.8990	-87.8839
SC 48	2.50	C, F, M	Dst/Ust Van Buren St.	41.8724	-87.8688
SC 28	1.50	C, F, M, S	Ust Gardner Ave.	41.8613	-87.8678
95-861		Trib to Addison Creek			
SC 25	0.50	C, F	Ust Forest View Rd.	41.9379	-87.9399
95-870		Spring Brook of SC			
SC 21	6.50	C, F	Dst Walnut Ct.	41.9720	-88.0801
SC 46	6.00	C, F, M	Dst Foster Ave.	41.9667	-88.0775
SC 18	4.50	C, F, M	@ end of Lakeview Dr.	41.9583	-87.0645
SC 47	2.50	C, F, M	Dst SR 53 (Rohlwing Rd)	41.9633	-88.0291
SC 16	0.25	C, F, M	Dst Prospect Ave.	41.9720	-87.9956
95-871		Meacham Creek			
SC 17	0.35	C, M	Dst Irving Park Rd/Medinah Country Club	41.9671	-88.0468

Table 5. Continued.

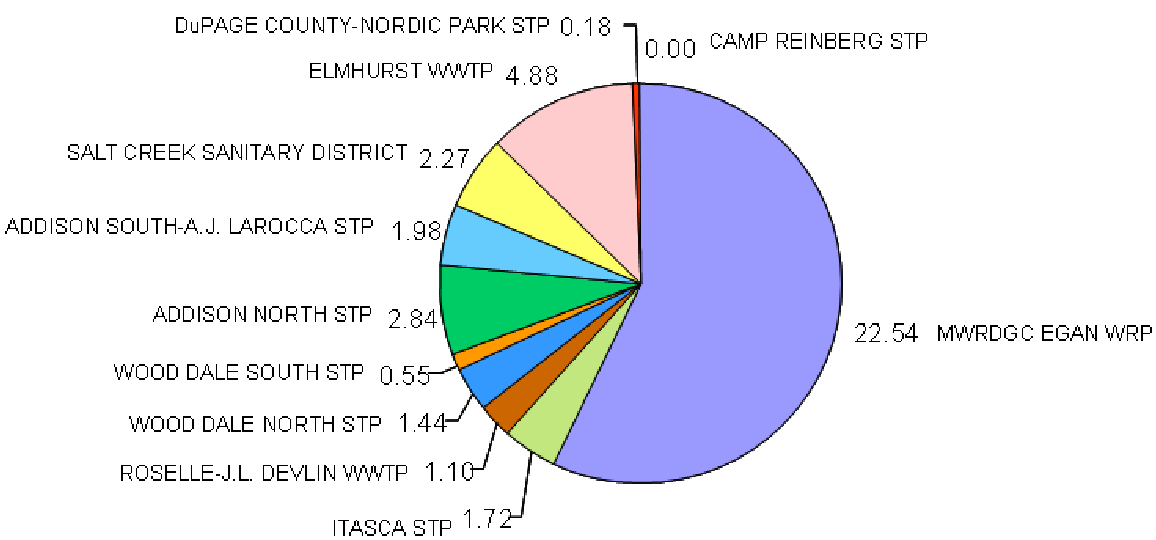
Site ID	River Mile	Samples	Location or Landmark	Latitude	Longitude
95-875		Oakbrook Creek			
SC 36	0.50	C, F	SR 83 & Hodges Rd behind Barnes and Nobles	41.8509	-87.9585
SC 32	0.25	C, F, M	16th St. @Citibank pkg. lot	41.8536	-87.9486
95-881		Trib to Meacham Creek			
SC 20	0.25	C, F, M	Behind Air-Liance Bldg. pkg . lot off Stevenson Ct.	41.9884	-88.0542
95-882		Westwood Creek			
SC 22	0.50	C, F, M	Dst Rozanne Drive	41.9400	-87.9906

Salt Creek Pollutant Loadings

Salt Creek is an effluent dominated stream during the summer base-flow period of July through October. For example, effluent made up approximately 68 percent of the flow at the USGS 05531300 gauge near Elmhurst during October of 2007. As such, water quality in the creek is strongly influenced by the quality of effluent it receives. Effluent quality data from major dischargers (those with a daily average flow [DAF] of 1 million gallons per day [MGD] or more) in the Salt Creek watershed were evaluated against permit limits to gauge the relative performance of each plant, especially with respect to plant flows (the amount of effluent leaving the plant) relative to treatment capacity, and concentrations of several key effluent constituents: bio-chemical oxygen demand (cBOD5), total suspended solids (TSS) and ammonia nitrogen (NH3-N).

Table 6. Publicly owned sewage treatment plants that discharge to the Salt Creek watershed, arranged by latitude. DAF is design average flow, DMF is design maximum flow. The accompanying pie chart shows the relative contribution of each plant as a percentage of the average effluent volume for September, 2007.

NPDES	Name	DAF (MGD)	DMF (MGD)	Receiving Stream	Longitude	Latitude
IL0048542	Camp Reinberg STP	.004	NA	Unnamed Tributary	-88.0617	42.1400
IL0036340	MWRDGC Egan WRP	30	50	Salt Creek	-88.0008	42.0153
IL0026280	Itasca STP	2.6	10	Salt Creek	-87.9919	41.9714
IL0030813	Roselle-J.L. Devlin WWTP	1.97	3.93	Spring Brook	-88.0767	41.9692
IL0028398	DuPage County Nordic	0.5	1.0	Spring Brook	-88.0281	41.9633
IL0020061	Wood Dale North STP	1.97	3.93	Salt Creek	-87.9850	41.9650
IL0034274	Wood Dale South STP	1.13	2.33	Salt Creek	-87.9831	41.9492
IL0021849	Bensenville South STP	4.7	10	Addison Creek	-87.9258	41.9478
IL0033812	Addison North STP	5.3	7.6	Salt Creek	-87.9869	41.9472
IL0027367	Addison South-A.J. Larocca STP	3.2	8	Salt Creek	-87.9739	41.9253
IL0030953	Salt Creek Sanitary District	3.3	8	Salt Creek	-87.9597	41.8853
IL0028746	Elmhurst WWTP	8	20	Salt Creek	-87.9589	41.8819



CAMP REINBURG SEWAGE TREATMENT PLANT [IL0048542] A minor discharger with a design flow of 0.004 million gallons per day (MGD), has been in compliance of permit terms since March, 2001.

MWRDGC EGAN WRP [IL0036340] The design average flow (DAF) for this treatment facility is 30 million gallons per day (MGD) and the design maximum flow (DMF) for the facility is 50 MGD. Treatment consists of screening, grit removal, settling tanks, aeration tanks, tertiary filtration, anaerobic digestion, gravity belt thickeners, and excess flow facilities. Excess flow is permitted only when the main treatment facility is receiving its maximum practical flow. Excess flows, when they occur, are required to be monitored. Monthly average limits for the excess discharges are 30 mg/l for BOD5 and TSS, 400 colonies/100 ml of fecal coliform, 0.75 mg/l for residual chlorine (used as a disinfectant). The 10-year recurrent 7-day low flow (Q7/10) of Salt Creek at the discharge point is 0 cubic feet per second (cfs).

Results of entity self monitoring between 2000 and 2007 show annual flows to be less than the design maximum capacity of 50 MGD in 98% of the cases (Figure 12). Accordingly, excess flows were report only 34 times between 1998 and 2007, and most occurred when flows at the 001 discharge were near the design maximum of 50 MGD (Figure 12), suggesting that the excesses were not associated with operation problems. Third quarter (i.e., July, August and September) plant flow rarely exceeded the design average capacity of 30 MGD (Figure 12). Third quarter data are used here and throughout the document given that flows are typically lowest and temperatures highest during the late summer-early fall period. Axiomatically, these conditions are the most critical for aquatic life. Treatment efficiency appears to have been stable throughout the time period of 2000 – 2007 given that flows were consistent between years and exceedences of permit limits for fecal coliforms (Figure 12), BOD5, TSS and ammonia (Figure 13) were rare or absent in most years.

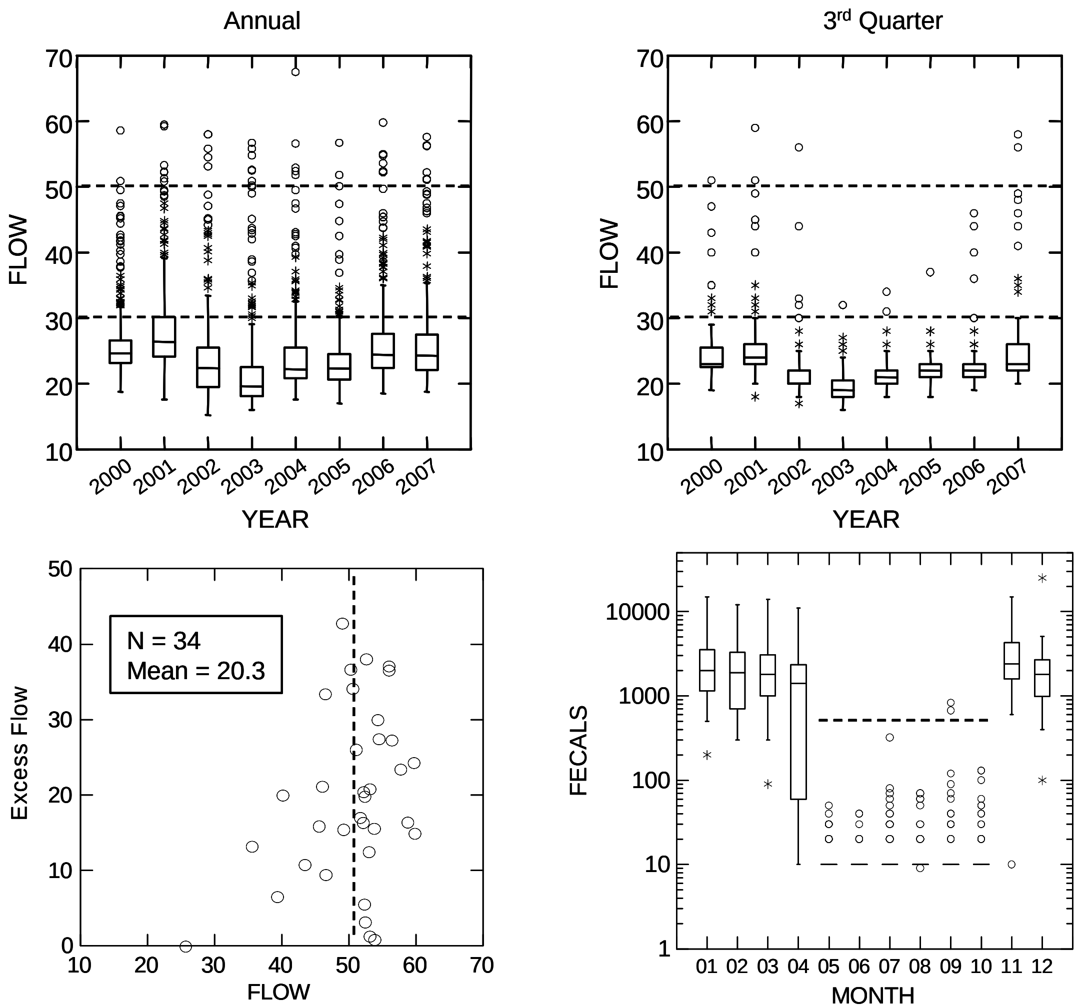


Figure 12. Annual and third quarter (July, August and September) plant flows (top panels) for the MWRDGC EGAN WRP [IL0036340] in relation to the plant's design maximum and design average (upper and lower dashed lines, respectively) flows. Data points represent reported daily averages and are in units of millions of gallons per day (MGD). The lower left panel shows excess flows reported by the plant between 2000 and 2007 subject to secondary treatment standards. The lower right panel shows distributions of fecal coliform counts (colonies/100 ml) in the plant effluent for 2000-2007 plotted by month. The limit for fecals (dashed line) applies for the months of May through November.

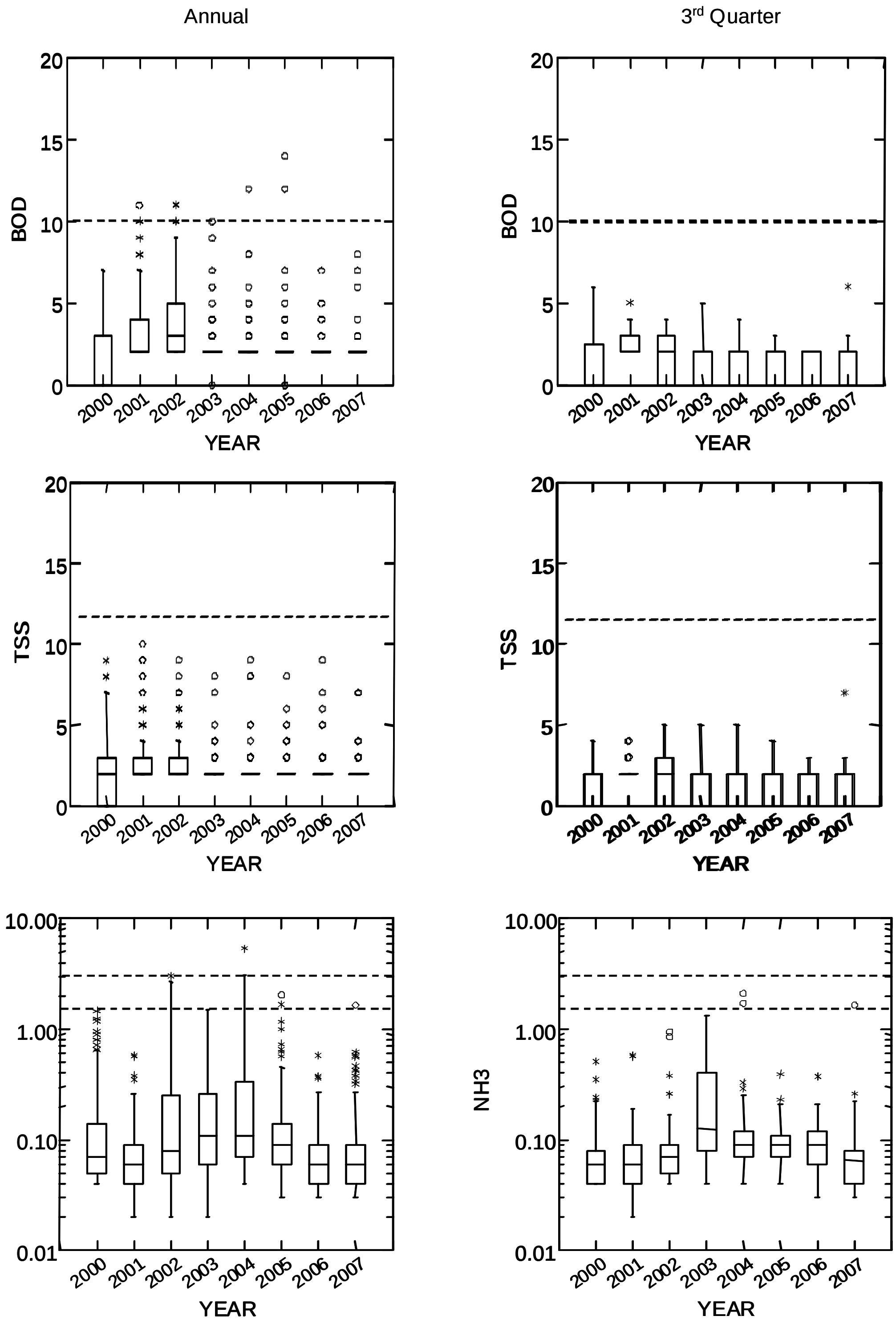


Figure 13. Annual and third quarter effluent concentrations (mg/l) for BOD5, TSS and NH3 (as ammonia-nitrogen) reported by the MWRDGC EGAN WRP [IL0036340] plant plotted by year. Effluent limits for the respective daily maximums are denoted by dashed lines (note that all values were less than the monthly average limits). The April through October limits are shown for both annual and third quarter plots as those limits are the most stringent, and therefore best reveal potential stressful events.

ITASCA STP [IL0026280] The Itasca Sewage Treatment Plant has a design average flow of 2.6 MGD and a design maximum flow of 10 MGD. Excess flows are permitted only when inflow reaches the maximum design capacity. Flows through the plant between 2000 and 2007 never exceeded the design maximum, and were within the average design capacity in 90% of the reported cases from entity self monitoring (Figure 14). Treatment efficiency was high, as evidenced by concentrations of BOD5 (Figure 14), TSS and NH3-N (Figure 15) being consistently within respective limits for the monthly average concentrations, and never exceeding daily maximums (for ammonia) during the summer low-flow period of July – September.

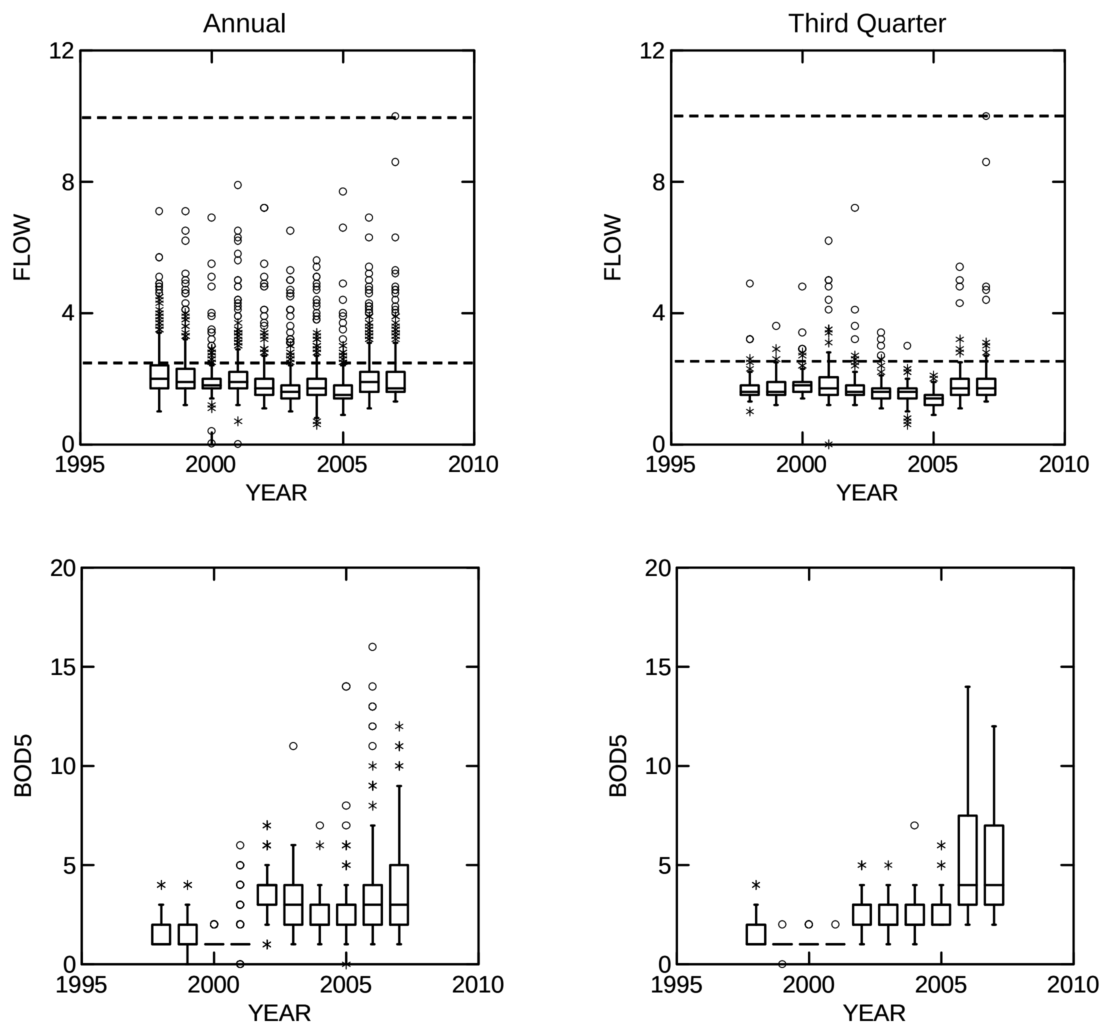


Figure 14. Annual and third quarter plant flows in millions of gallons per day, and effluent BOD5 concentrations (mg/l) for the Itasca STP. Plant design maximum and design average flow are shown in the upper panels as stippled lines. All BOD5 concentrations were below permitted limits.

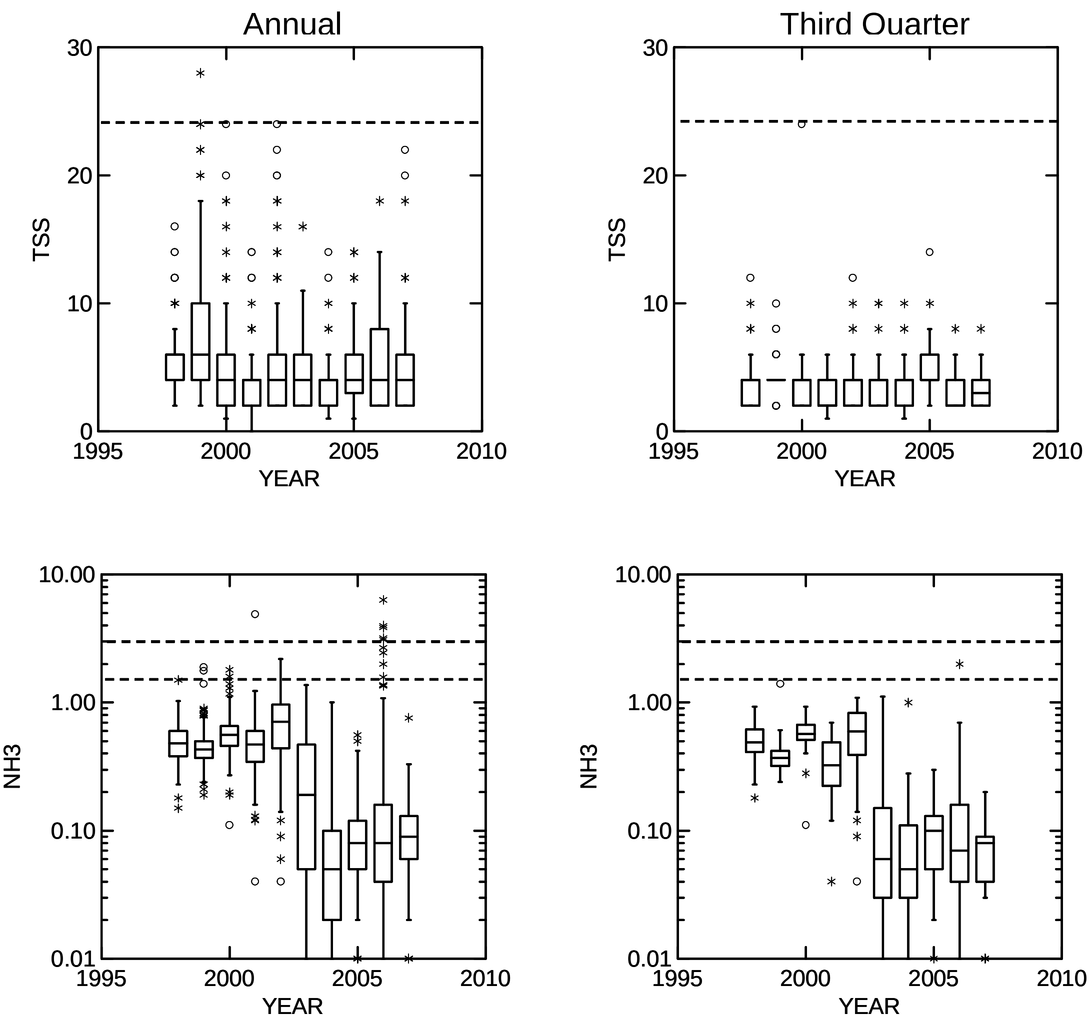


Figure 15. Annual and third quarter effluent concentrations (mg/l) for TSS and NH3 reported by the Itasca STP plotted by year. Effluent limits for respective monthly averages are denoted by dashed lines. The April through October limits are shown for ammonia.

ROSELLE- J.L. DEVLIN WWTP [IL0030813] Treatment consists of screening, primary clarifiers, activated sludge, sedimentation, filtration, disinfection, sludge handling facilities, and excess flow treatment. The design average flow (DAF) for the facility is 2.0 million gallons per day (MGD) and the design maximum flow (DMF) for the facility is 4.0 MGD. The 10-year recurrent 7-day low flow (Q7/10) of the receiving stream, Springbrook Creek, is 0 cfs. Self-monitoring data from the plant was not supplied for this project. Data reported by the plant to US EPA's Permit Compliance System (PCS) data warehouse show no violations between September, 2006 and February, 2008. However, within this time period, maximum plant flows exceeded the design maximum in 9 of 18 months, with maximum flows of 8.5 MGD reported for December, 2006. The excess flows were presumably treated per standards for secondary treatment.

WOOD DALE NORTH STP [IL0020061] The design average flow (DAF) for the treatment facility is 1.97 million gallons per day (MGD) and the design maximum flow (DMF) for the facility is 3.93 MGD. Median annual flows from the plant between 2002 and 2007 were less than the design average flow, and peak flows rarely exceeded the design maximum, especially during the third quarter (Figure 16). Fecal coliforms did not exceed the daily maximum permit limit 400 colonies/100 ml at any time between 2002 and 2007 (Figure 16). Effluent concentrations for cBOD5, TSS and NH3-N consistently met permit limits for respective weekly averages (Figure 17).

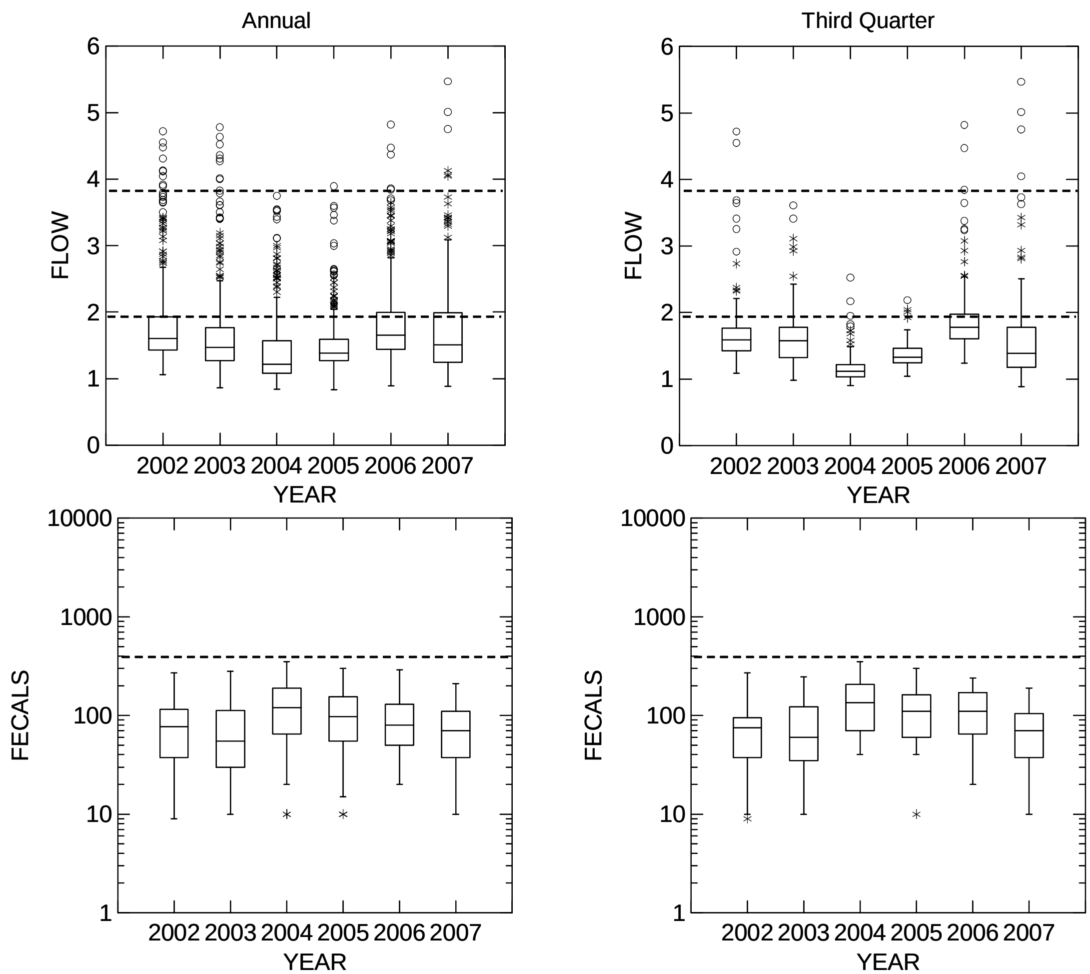


Figure 16. Annual and third quarter plant flows (top panels, in MGD) and effluent fecal counts (colonies/100ml) for the Wood Dale North STP. Plant design maximum and design average flow are shown in the upper panels as dashed lines. The 400 colonies/100 ml fecal daily maximum limit is similarly depicted.

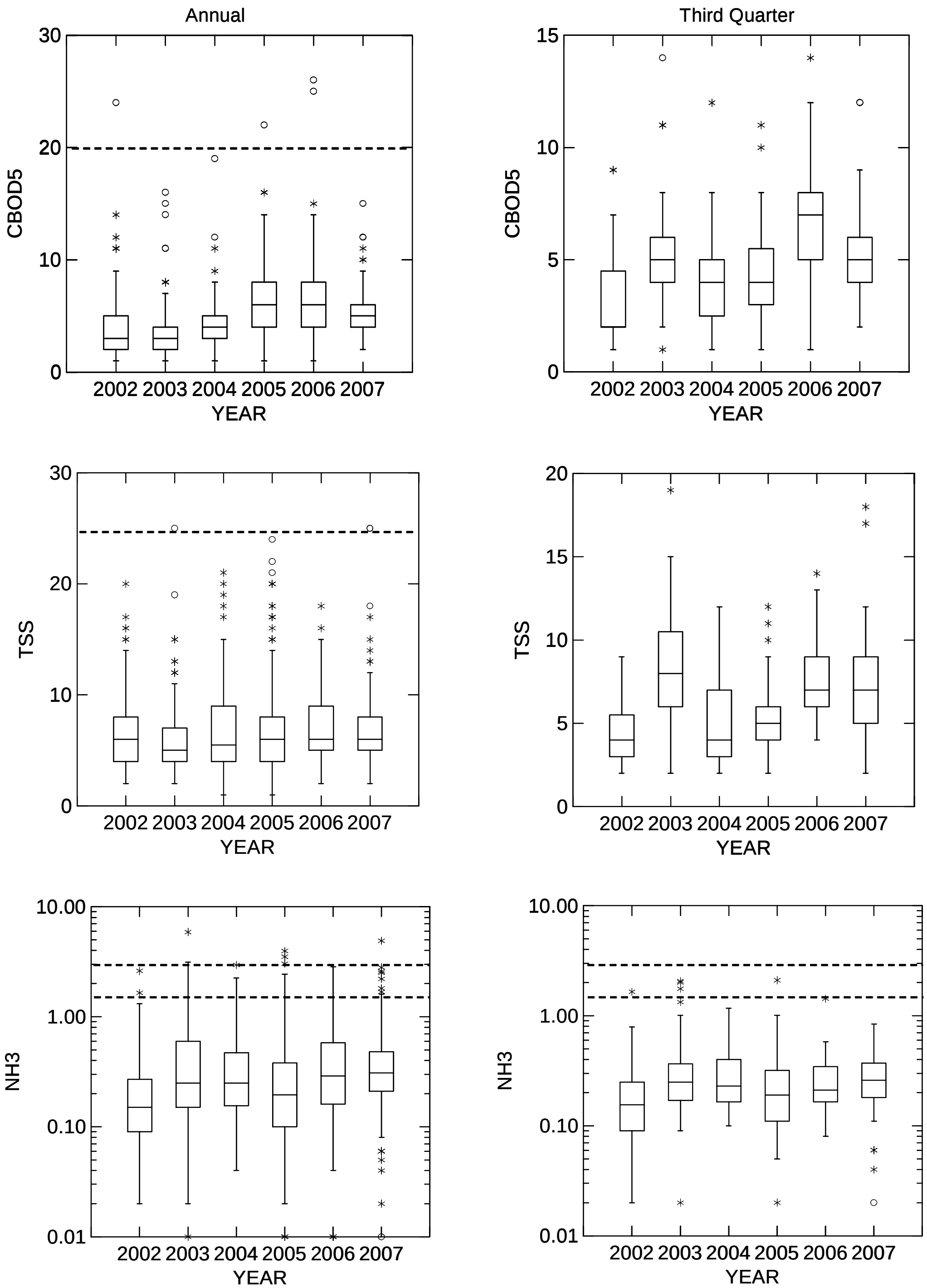


Figure 17. Annual and third quarter effluent concentrations (mg/l) for cBOD5, TSS and NH3 reported by the Wood Dale North plant plotted by year. Effluent limits for monthly averages are shown as dashed lines in the annual cBOD5 and TSS plots (note that the respective weekly average limits of 40 and 45 mg/l are beyond the limits of the y-axes). The April through October monthly average and daily maximum effluent limits are denoted by dashed lines for the ammonia-nitrogen plots.

WOOD DALE SOUTH STP [IL0034274] The design average flow (DAF) for the treatment facility is 1.13 million gallons per day (MGD) and the design maximum flow (DMF) for the facility is 2.33 MGD. Median annual flows from the plant between 2002 and 2007 were less than the design average flow, and peak flows rarely exceeded the design maximum, especially during the third quarter (Figure 18). Fecal coliforms did not exceed the permit limit of 400 ml/l at any time between 2002 and 2007 (Figure 18). Effluent concentrations for cBOD5, TSS and NH3-N consistently met permit limits for respective weekly averages (Figure 19).

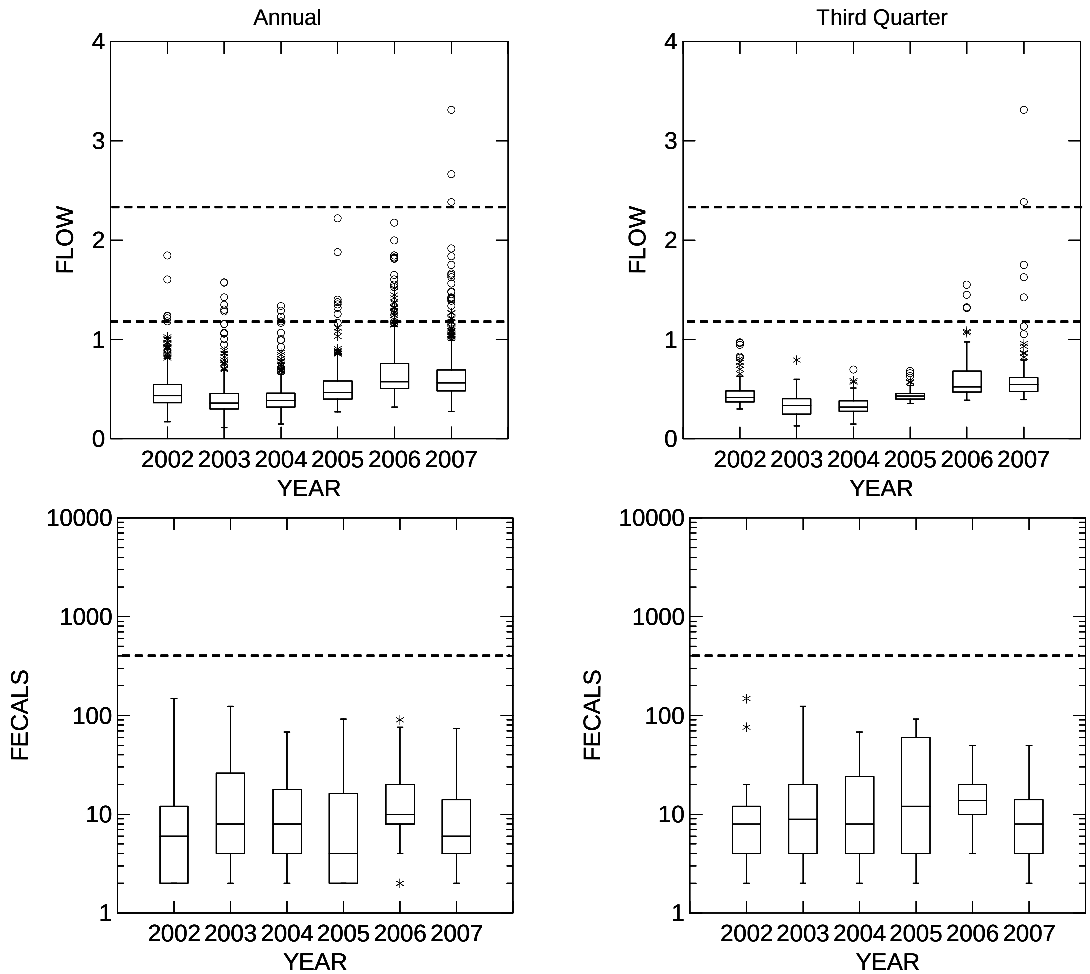


Figure 18. Upper panels, annual and third quarter plant flows (MGD). Lower panels, effluent fecal counts (colonies/100 ml) for the Wood Dale South STP. Plant design maximum and design average flow are shown in the upper panels as dashed lines. The 400 colonies/100 ml daily maximum fecal limit is similarly depicted.

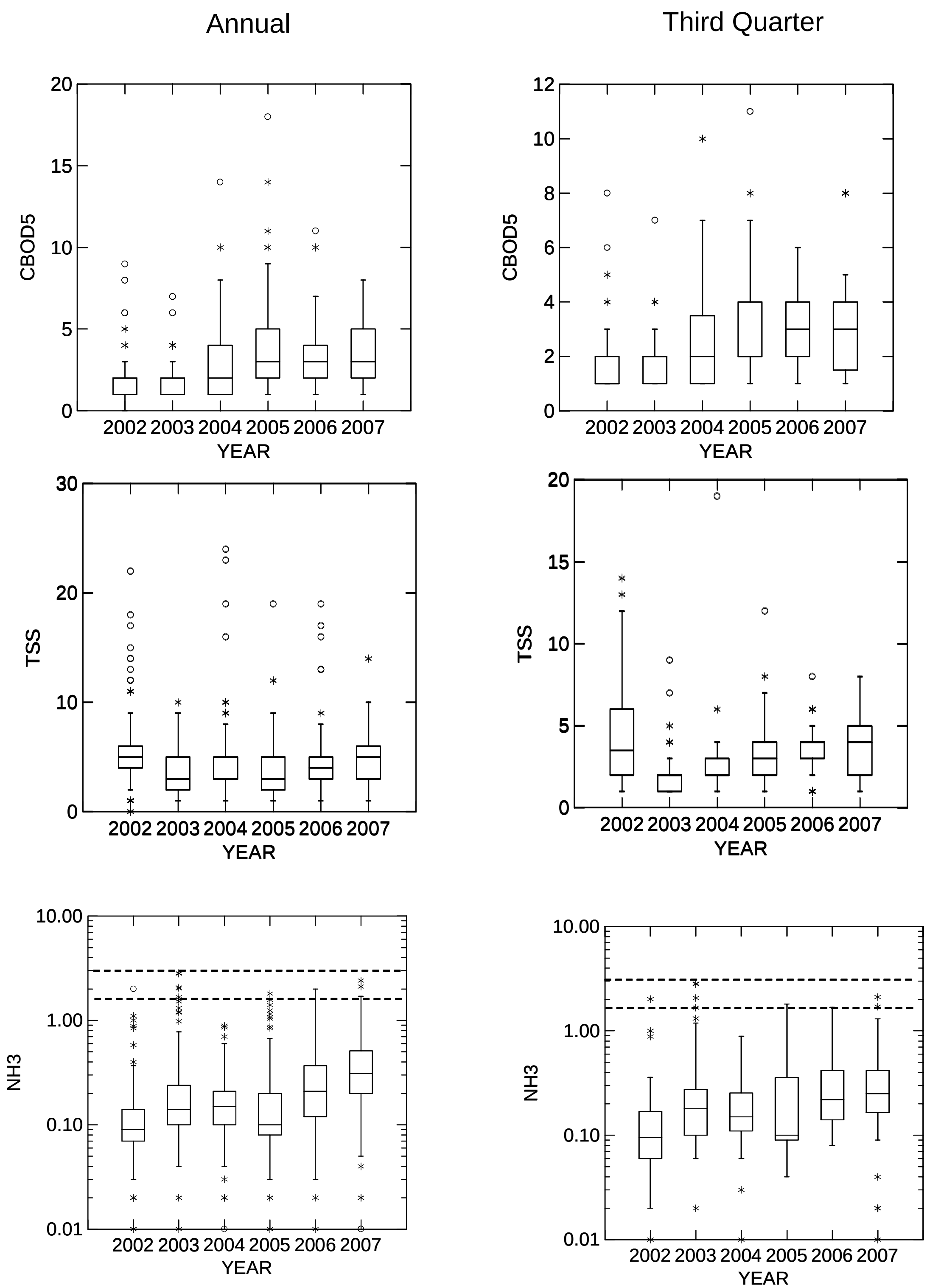


Figure 19. Annual and third quarter effluent concentrations (mg/l) for cBOD5, TSS and NH3 reported by the Wood Dale South plant plotted by year. Monthly and weekly average effluent limits for cBOD5 and TSS are denoted by dashed lines. The April through October monthly average and daily maximum limits are shown for ammonia.

SALT CREEK SANITARY DISTRICT STP [IL0030953] The 10-year recurrent 7-day low flow (Q7/10) of the receiving stream is 32 cfs (21MGD). The design average flow for this treatment facility is 3.3 million gallons per day and design maximum flow for the facility is 8.0 MGD. Treatment consists of screening, pre-aeration, primary clarification, aeration, final clarification, filtration, chlorination, dechlorination, anaerobic digestion and sludge dewatering/application. Median annual and third quarter flows from the plant between 2000 and 2007 were below the average design capacity. Flows were higher in 2006 and 2007 than the preceding five years (Figure 20), but treatment did not appear comprised as effluent concentrations of cBOD5, TSS and NH3-N remained below limits for respective weekly average concentrations (Figure 21).

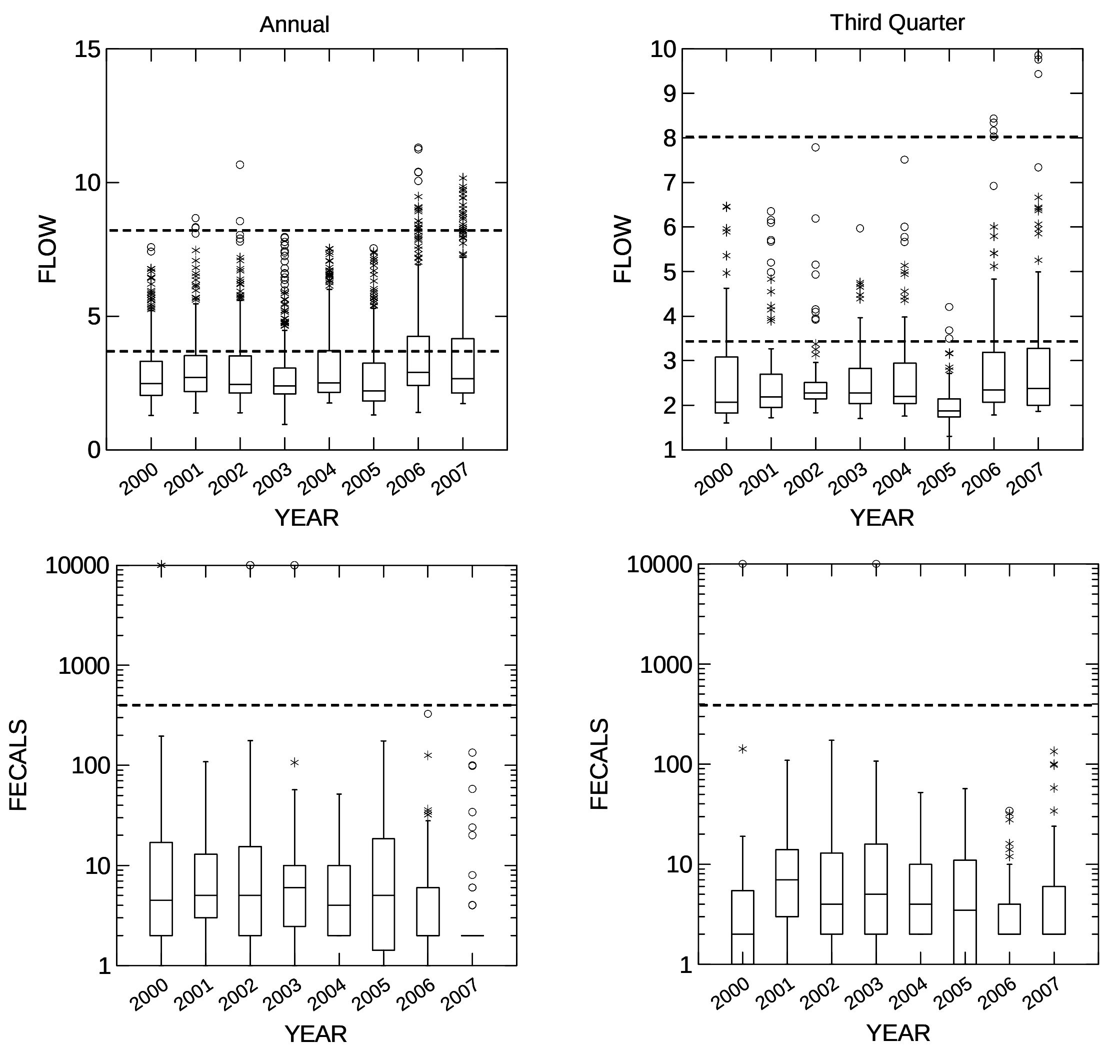


Figure 20. Annual and third quarter plant flows (in MGD, top panels) and effluent fecal counts (colonies/100 ml) for the Salt Creek Sanitary District WWTP. Plant design maximum and design average flow are shown in the upper panels as dashed lines. The 400 colonies/100 ml fecal daily limit is similarly depicted.

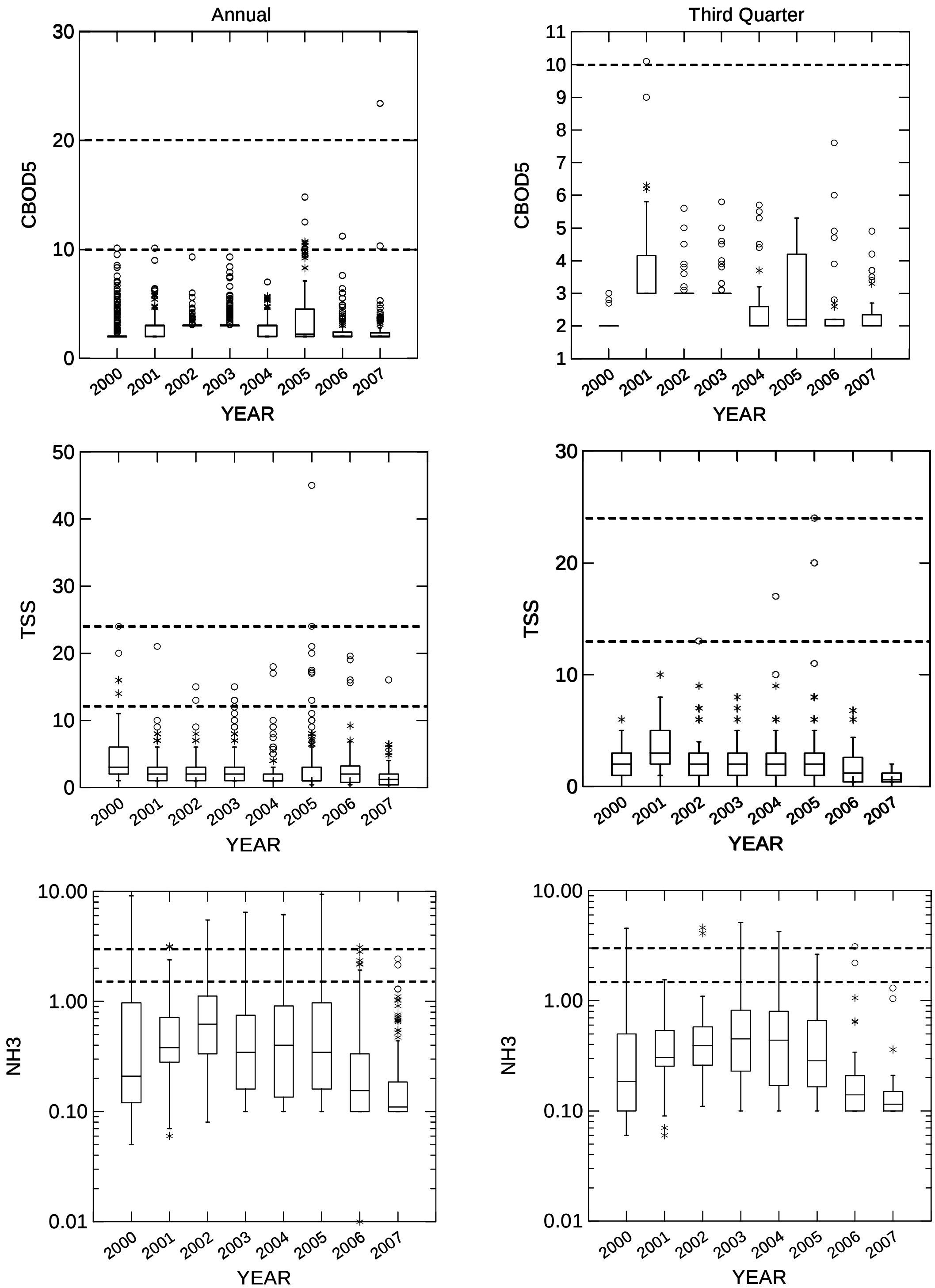


Figure 21. Annual and third quarter effluent concentrations (mg/l) for cBOD5, TSS and NH3 reported by the Salt Creek Sanitary District plant plotted by year. Monthly and weekly average effluent limits for cBOD5 and TSS are denoted by dashed lines. The April through October monthly average and daily maximum limits are shown for ammonia.

DUPAGE COUNTY NORDIC PARK STP [IL0028398] The Nordic Park Sewage Treatment Plant is classed a minor discharger, with a design average flow of 0.5 MGD. Median annual flows for 2000 to 2007 were below the average design flow. Annual 95th percentile flows exceeded the average design in 2001 and 2002, but third quarter 95th percentile flows were below the average design in all years (Figure 22). Treatment efficiency appears to be consistent between 2000 and 2007 as annual and third quarter effluent concentrations for fecal coliforms, cBOD5, NH3 and TSS were well below respective permitted limits (Figure 23). Note, however, that starting in 2003, fewer effluent quality samples were collected, and in the case of ammonia, two of twenty-six third quarter observations (7.7%) were elevated.

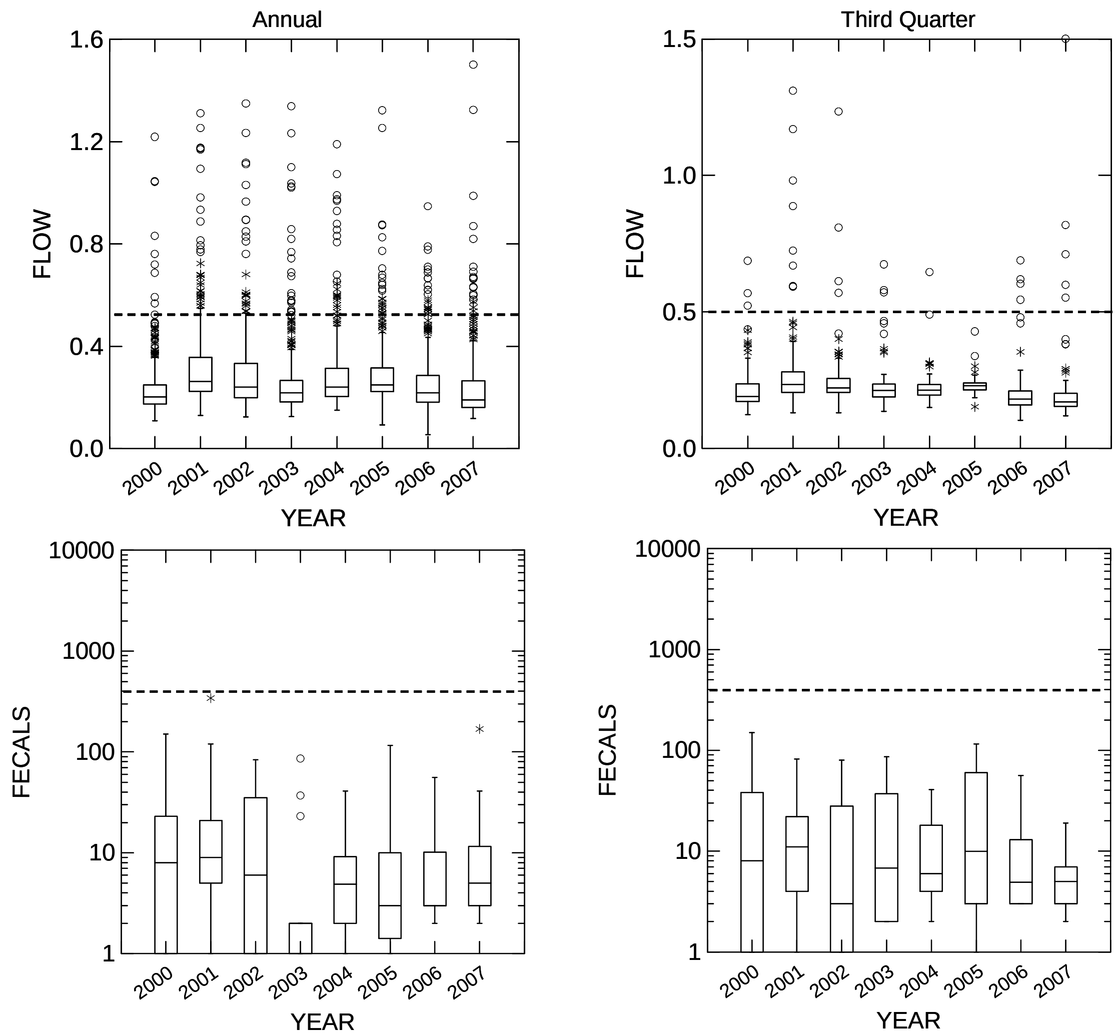


Figure 22. Annual and third quarter plant flows (in MGD, top panels) and effluent fecal counts (colonies/100 ml) for the DuPage County Nordic Park STP. Plant design maximum and design average flow are shown in the upper panels as dashed lines. The 400 colonies/100 ml fecal daily maximum limit is similarly depicted.

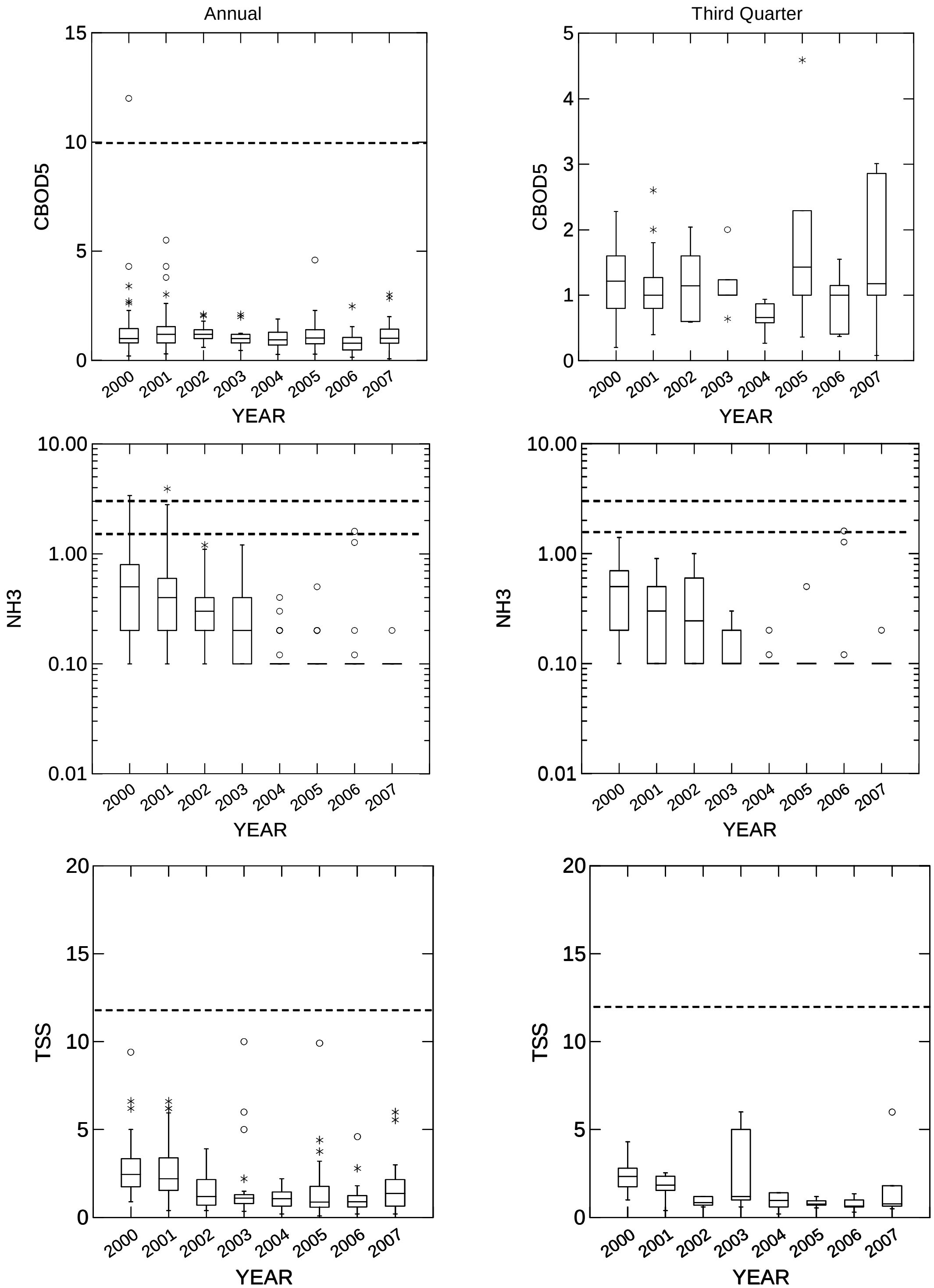


Figure 23. Annual and third quarter effluent concentrations (mg/l) for cBOD5, NH3 and TSS reported by the DuPage County Nordic Park STP plotted by year. Monthly and weekly average effluent limits for cBOD5 and TSS are denoted by dashed lines. The April through October monthly average and daily maximum limits are shown for ammonia.

CITY OF ELMHURST STP [IL0028746] The Elmhurst Sewage Treatment Plant has an average design flow of 8.0 million gallons per day (MGD), and a design maximum flow of 20 MGD. Median annual effluent flows for the period 1997 through 2006 were less than 8 MGD, and maximum flows rarely exceeded 20 MGD (Figure 24). Effluent concentrations for 5-day carbonaceous biological oxygen demand (cBOD5), total suspended solids (TSS) and ammonia-nitrogen (NH3-N) rarely exceeded maximum weekly or daily limits (Figure 24), and did not exceed monthly average limits. Third quarter (July – September) flows averaged about 6 MGD, and 75th percentiles were less than the average design flow (Figure 25). Third quarter effluent concentrations of cBOD5, TSS and NH3-N were typically well below permit limits for maximum daily discharge (Figure 25). NH3-N concentrations exceeded the daily maximum limit of 2 mg/l in 2 percent of the cases for the period of record, but exceeded the daily maximum only once in the last three years. Treatment efficiency appears consistent as inferred from plots of third quarter fecal coliforms and TSS in relation to plant flows given that counts and concentrations, respectively, show no relation with flow.

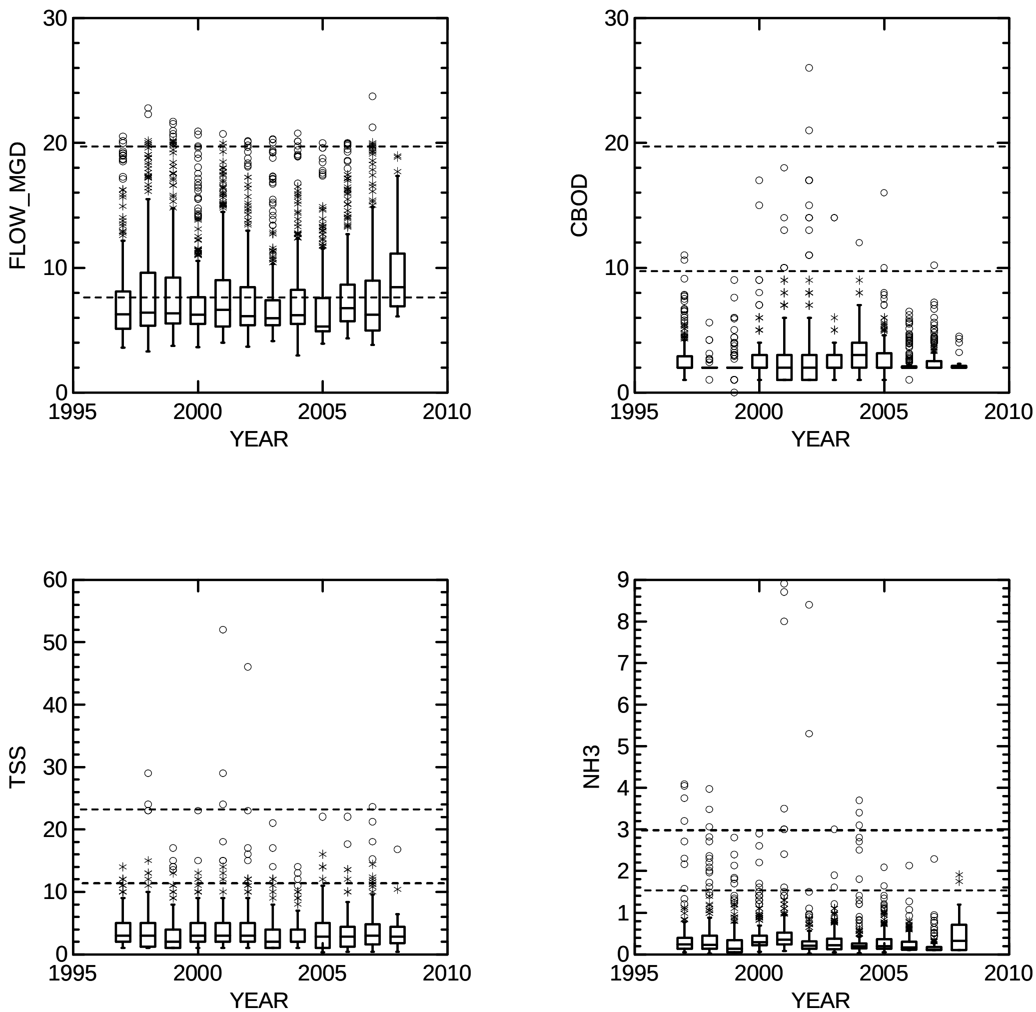


Figure 24. Annual plant flows (in MGD) and annual effluent concentrations (mg/l) of cBOD5, TSS and NH3 for the Elmhurst STP. Dashed lines follow the usual conventions of depicting limits.

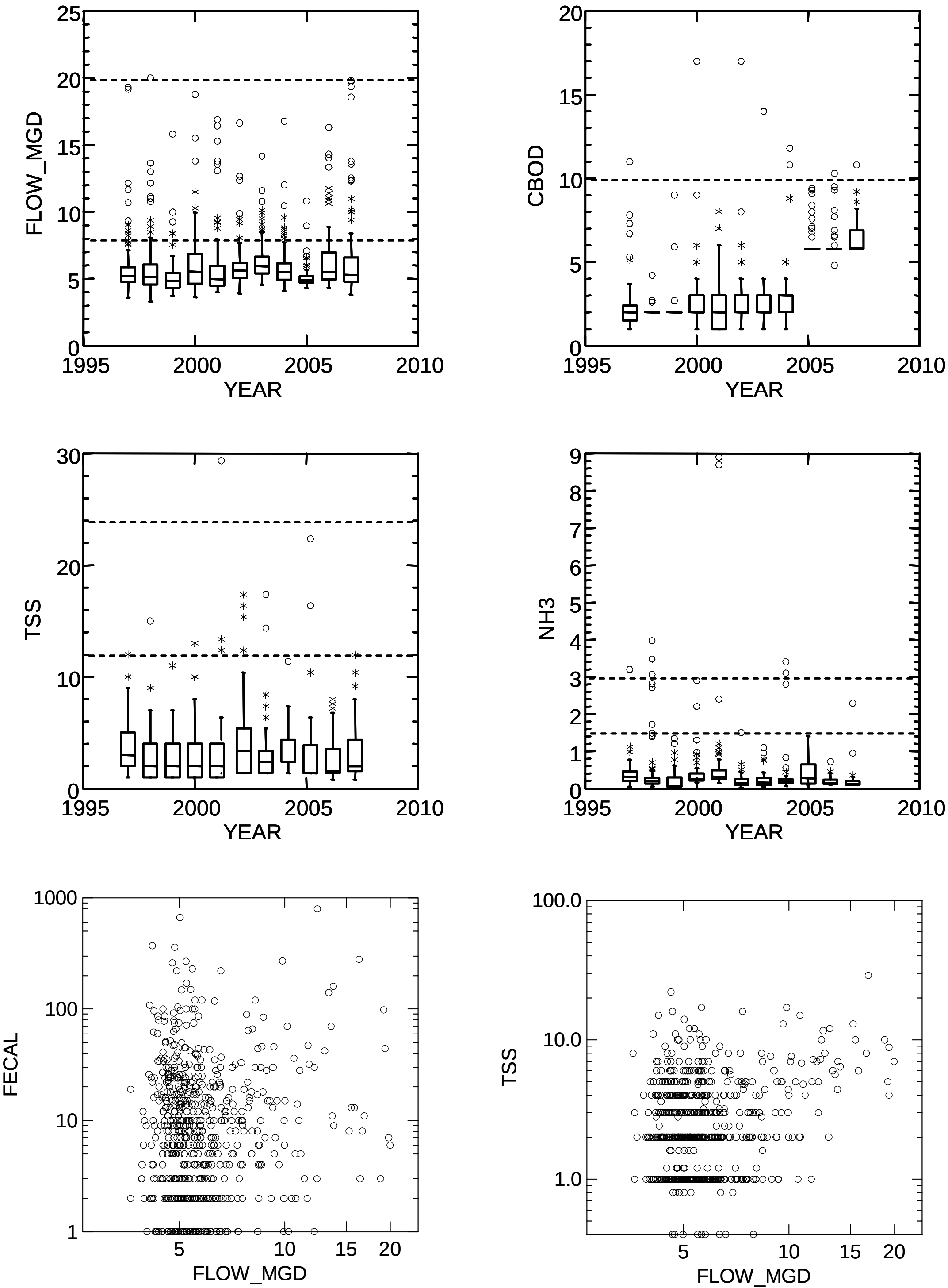


Figure 25. Upper and middle panels, third quarter plant flows (in MGD) and concentrations (mg/l) of cBOD5, TSS and NH3 in relation to applicable limits (as dashed lines) for the Elmhurst STP [IL0028746]. Lower panels, fecal colony counts (per 100 ml) and TSS concentrations (mg/l) plotted in relation to plant flows, 1995 and 2007. Note that the concentrations of fecal coliforms and TSS do not increase with increasing plant flows, indicating consistent treatment efficiency throughout the range of plant flows.

ADDISON NORTH STP [IL0033812] The design average flow (DAF) for the treatment facility is 5.3 million gallons per day (MGD) and the design maximum flow (DMF) for the facility is 7.6 MGD. Treatment consists of screening, 2 stage activated sludge treatment clarification, excess flow treatment and effluent disinfection. Sludge is both aerobically and an aerobically digested, belt pressed and applied to agricultural land. Annual self-monitoring data show the plant was operated below average design capacity between 1998 and 2007, and rarely exceeded the design maximum (Figure 26). Third quarter flows were also typically less than the design average, and the maximum design capacity was only exceeded five times in ten years. Effluent concentrations of cBOD5, TSS and NH3 (Figure 27) were consistent across years and did not exceed applicable limits, suggesting treatment efficiency at the plant was high. Excess flows from the plant occurred 113 times between 1998 and 2007. When excess flows did occur, secondary treatment standards were always met for cBOD5 and TSS, and nearly always for fecal coliforms (Figure 28).

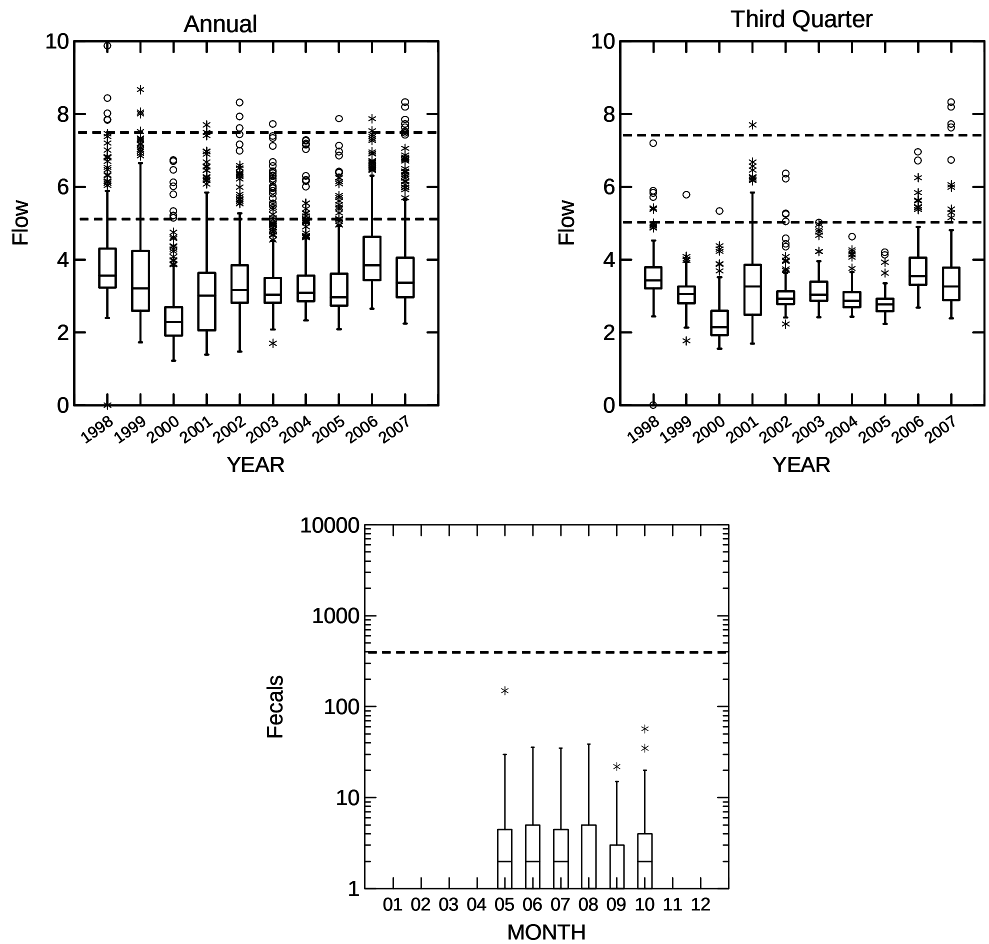


Figure 26. Annual and third quarter plant flows (top panels) annual effluent fecal counts for the Addison North STP. Plant design maximum and design average flow are shown in the upper panels as dashed lines. The 400 colonies/100 ml fecal limit is similarly depicted.

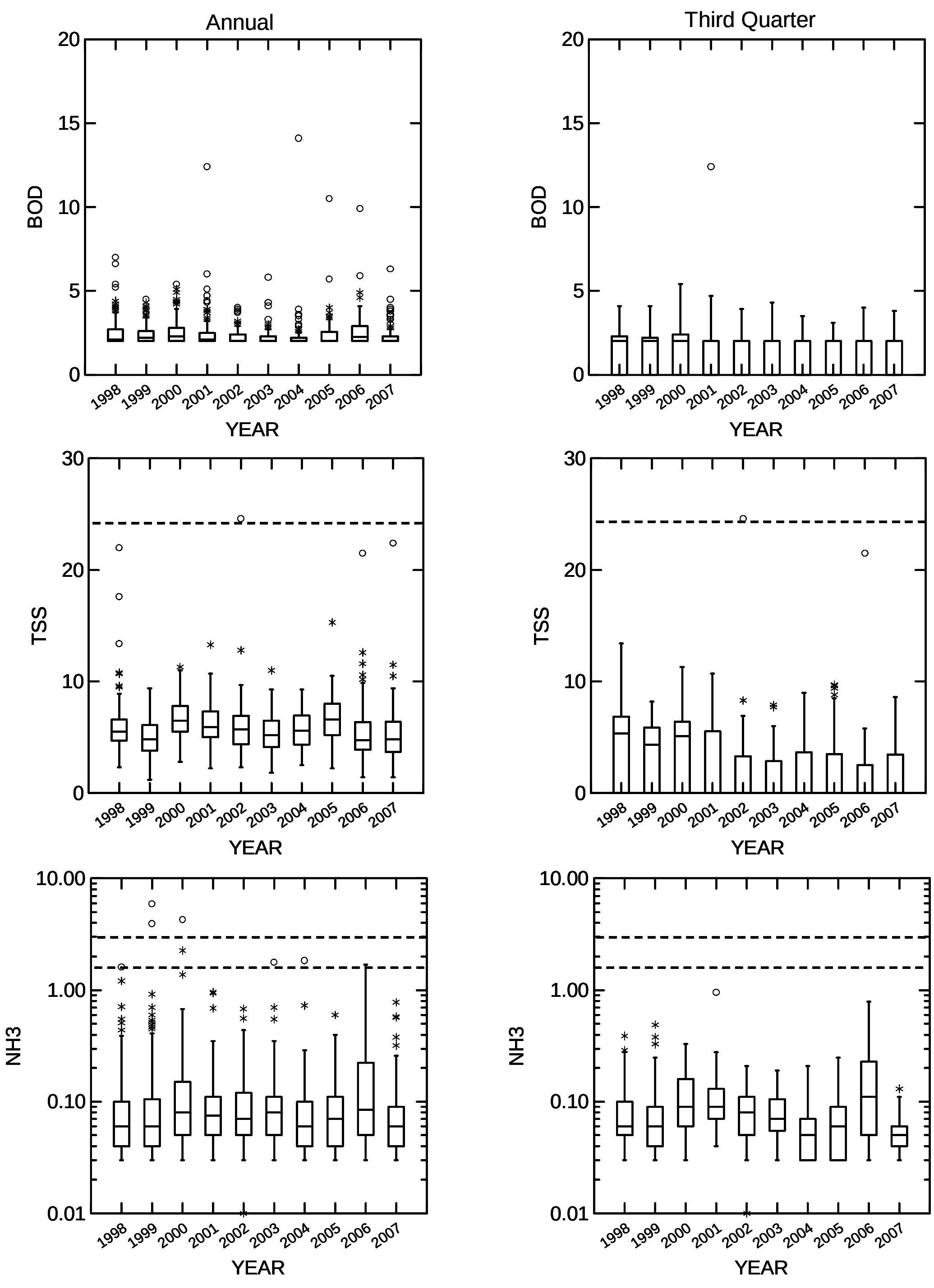


Figure 27. Annual and third quarter effluent concentrations (mg/l) for cBOD5, NH3 and TSS reported by the Addison North STP plotted by year. The weekly average effluent limits for TSS is denoted by dashed lines (note that all cBOD5 values fell below the monthly average limit of 20 mg/l). The April through October monthly average and daily maximum limits are shown for ammonia.

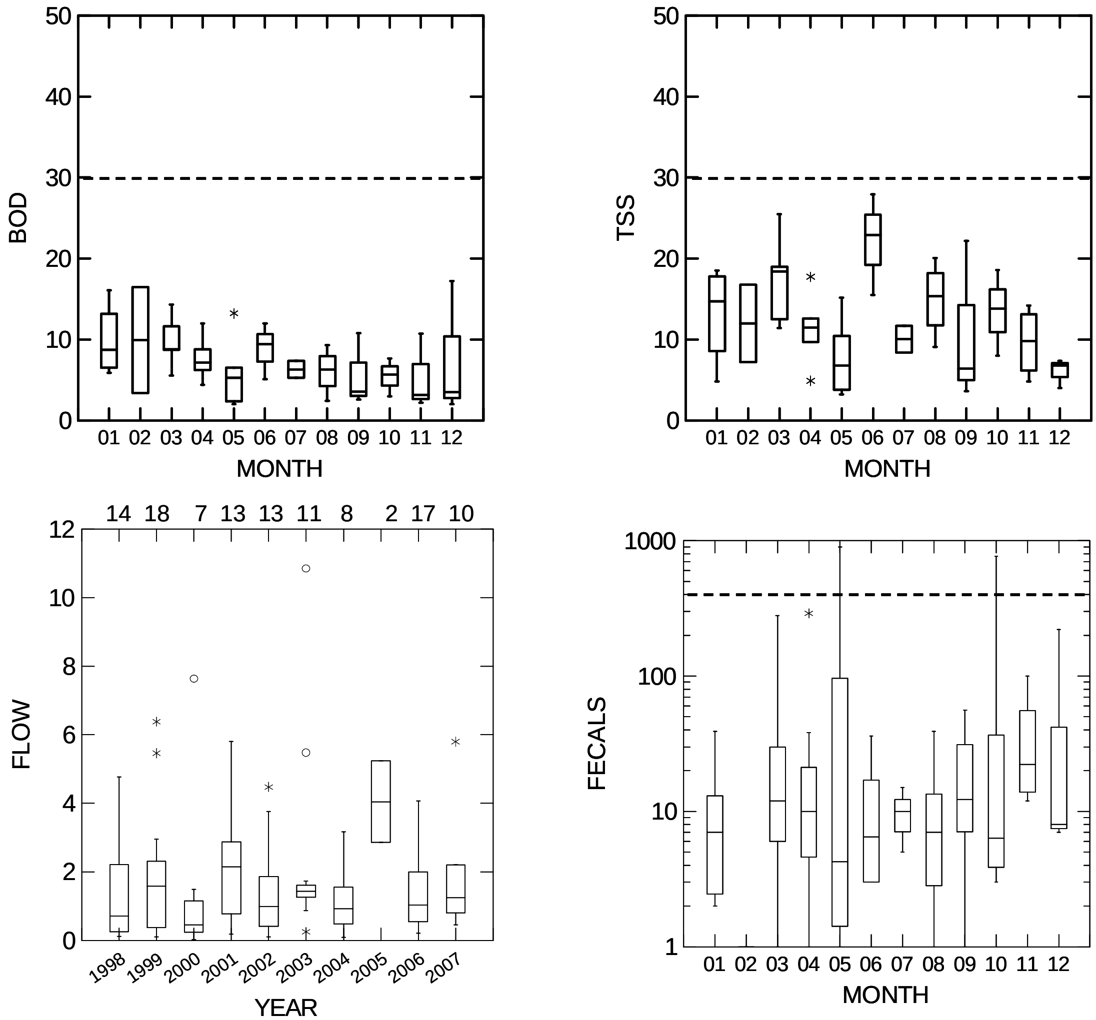


Figure 28. Concentrations of cBOD5, TSS, flow volume and fecal counts in excess plant flows reported by the Addison North STP 1998 – 2007. The numbers at the top of the flow plot (lower left) are counts of excess flows reported for each year. Dashed lines show the respective secondary treatment standards.

Addison South (A. J. Larocca) STP [IL0027367] The design average flow (DAF) for the treatment facility is 3.2 million gallons per day (MGD) and the design maximum flow (DMF) for the facility is 8.0 MGD. Treatment consists of screening, grit removal primary settling, activated sludge, secondary settling chlorination and dechlorination. Sludge is stabilized with anaerobic digestion. Addison South is authorized to treat and discharge excess flow as follows through a combined sewer outfall (CSO) subject to secondary treatment standards as outlined in 40 CFR 133.102. Annual and third quarter median flows from the plant for the period from 1998 to 2007 averaged about one half the design average flow, and 95th percentile flows never exceeded the design maximum (Figure 29). The quality of treated effluent was consistent and met applicable limits in all years except for in one instance where NH3 concentrations exceeded the daily maximum of 3.0 mg/l on 20 June 2006 (Figure 30). CSO discharges occurred 95 times over the ten year period. Concentrations of oxygen demanding substances, though typically within permit limits for secondary treatment, were an order of magnitude higher than that in the normally treated effluent (Figure 31).

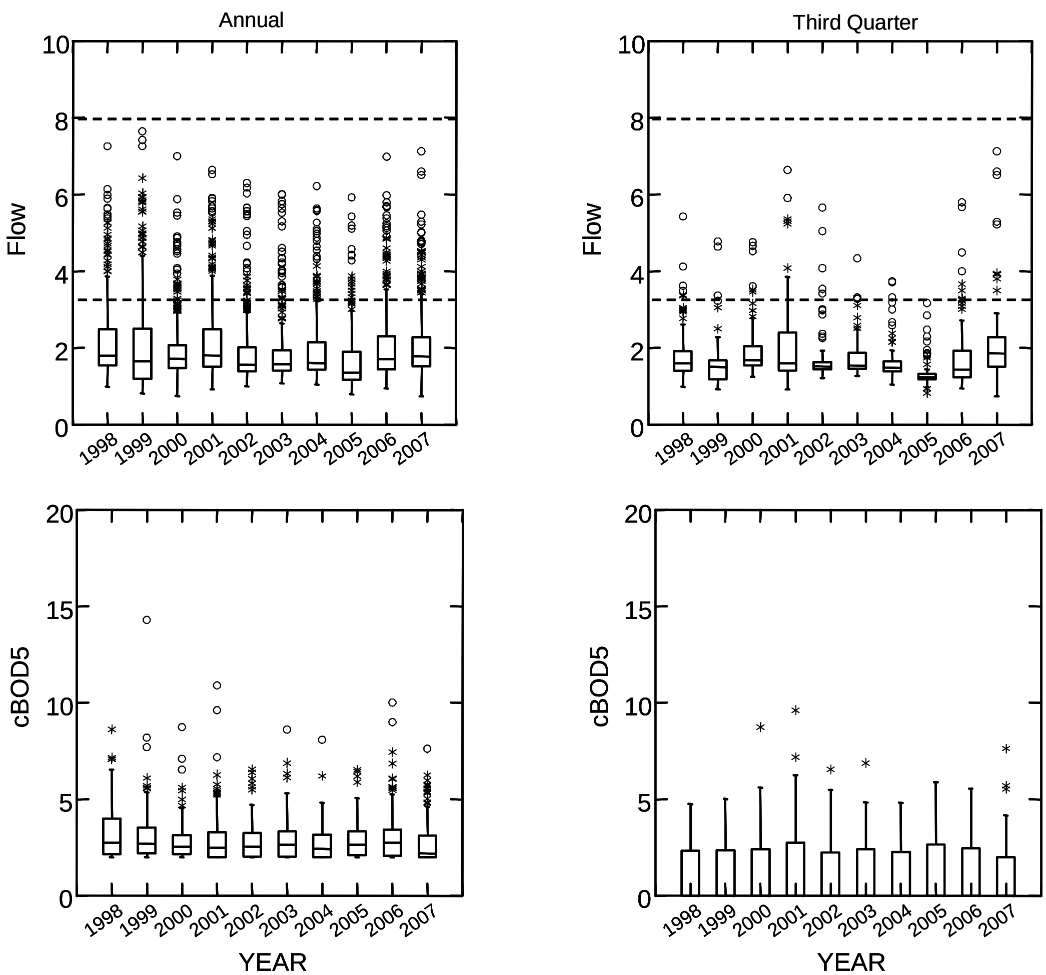


Figure 29. Annual (left panels) and third quarter (right panels) plant flows and cBOD5 concentrations from the Addison South (A. J. Larocca) STP (note that the weekly average limit for cBOD5 is 20 mg/l). Plant design maximum and average flows are noted in the flow plots by dashed lines.

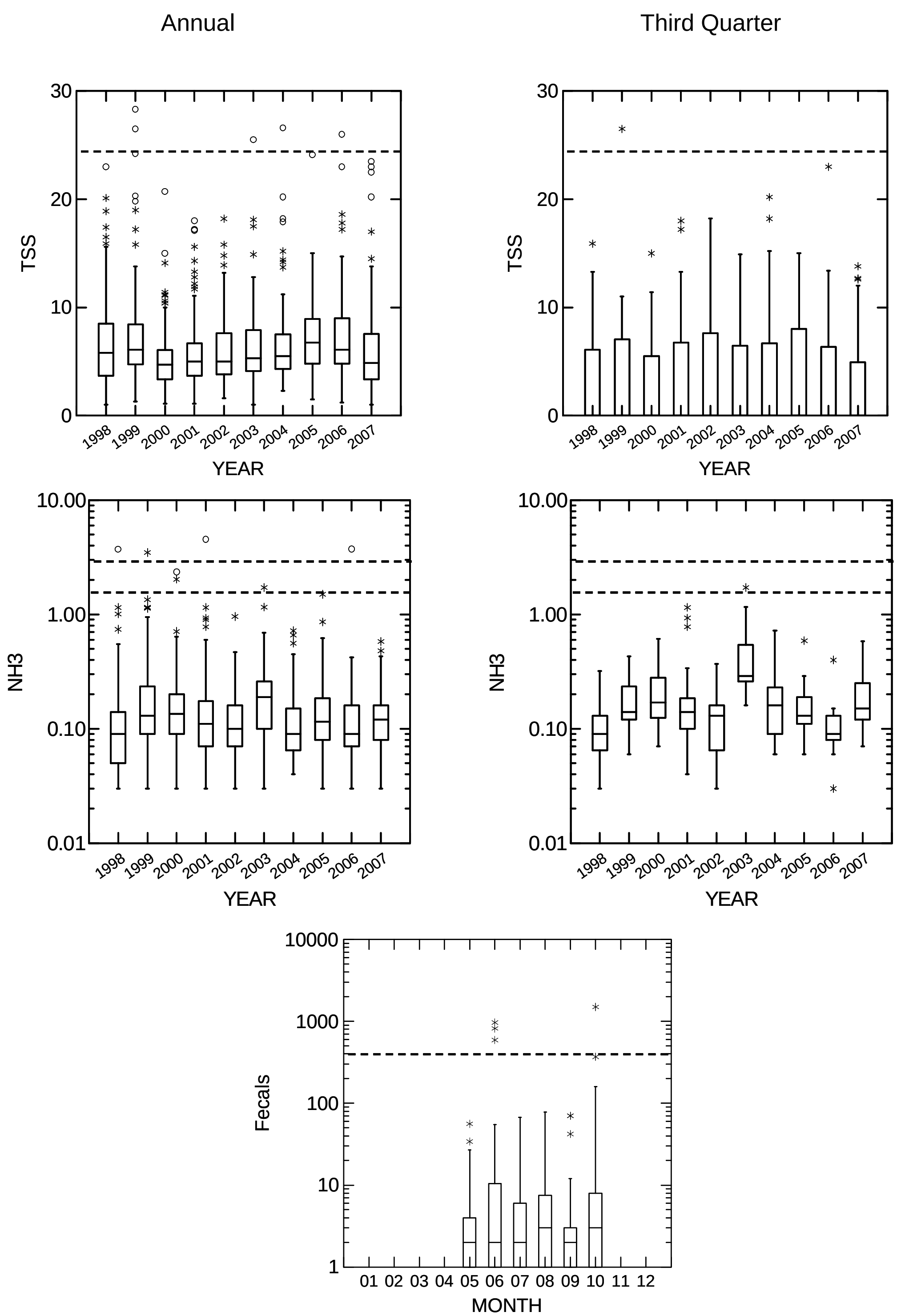


Figure 30. Annual (left) and third quarter (right) effluent concentrations for TSS and NH3 by the Addison South (A. J. Larocca) STP. The monthly average limit for TSS is noted by a dashed line. The April through October monthly and daily limits are shown for ammonia. Lower panel, annual effluent fecal counts (colonies/100 ml) for May through October 1998-2002 in relation to the 400 colonies/100 ml daily limit.

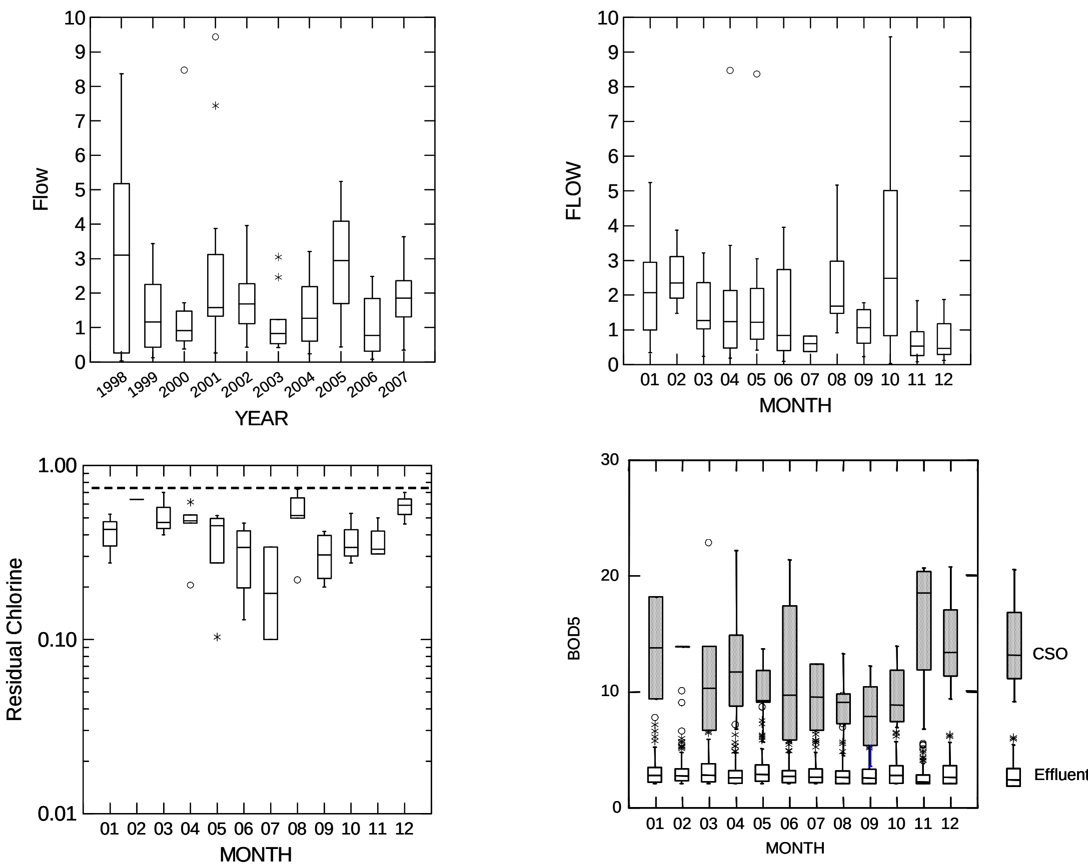


Figure 31. Combined sewer overflow (CSO) discharges reported by the Addison South (A. J. Larocca) STP 1998-2007. Upper left panel shows the distribution of flow volumes (MGD) by year. The upper right panel shows the same data plotted by month. Lower panels: residual chlorine and BOD5 concentrations in CSO discharges receiving secondary treatment plotted by month for the 1998-2007 time period. BOD5 concentrations in the regularly treated effluent are shown for comparison.

BENSENVILLE SOUTH STP [IL0021849] The main discharge number is 001. The 10-year recurrent 7-day low flow (Q7/10) of the receiving stream, Addison Creek, is 0 cfs. The design average flow (DAF) for the treatment facility is 4.7 million gallons per day (MGD) and the design maximum flow (DMF) for the facility is 10 MGD. Treatment consists of screening, grit removal, primary treatment trickling filtration, activated sludge, sedimentation, tertiary filtration, disinfection and sludge handling facilities. Third quarter effluent data from 2004-2007 showed that plant was operating within permit limits over the period. Effluent flows averaged well below the plant's design average capacity, and maximum daily limits for ammonia, cBOD5 and TSS were not exceeded (Figure 32).

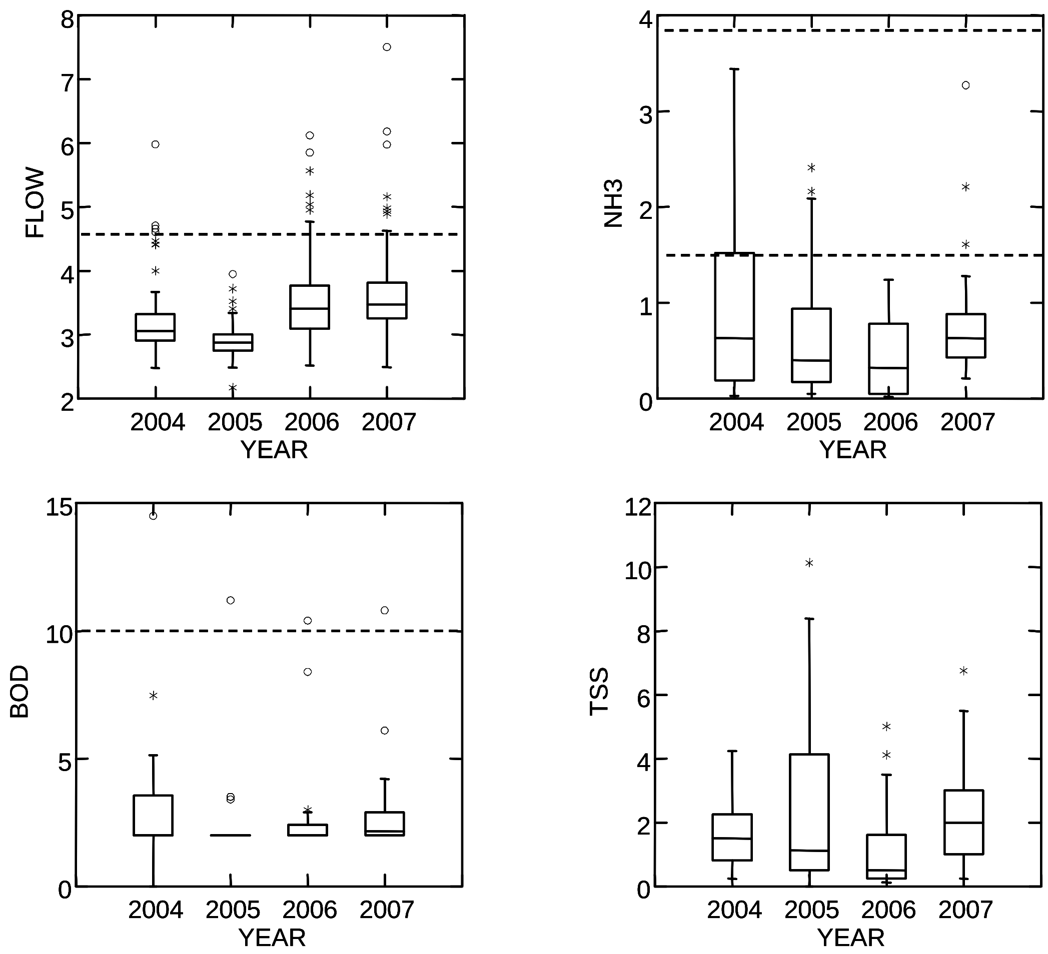


Figure 32. Third quarter plant flows, and effluent ammonia, cBOD5 and TSS concentrations (mg/l) for the Bensenville South STP. Dashed lines in the ammonia plot show the monthly average (1.5 mg/l) and the weekly average (3.9 mg/l) limits applicable in July and August. The dashed line in the cBOD5 plot shows the monthly limit. Note all values for cBOD5 were less than the daily maximum of 20 mg/l. The monthly average limit for TSS is 12 mg/l.

Water Chemistry – Salt Creek
Treated municipal effluent constitutes approximately 60-70% of the flow in Salt Creek during the summer. Accordingly, the concentrations of its chemical constituents, especially total phosphorus, reflect the high effluent load (Figure 33). Phosphorus concentrations in the reach between the Egan WRP and the Elmhurst WWTP increase by one order of magnitude relative to those measured upstream. Little or no assimilation of the phosphorus load is evident in the reach between the Elmhurst WWTP and the confluence of Salt Creek with the Des Plaines River. However, nutrient enrichment in this reach is evidenced by elevated total Kjeldahl nitrogen (TKN) and wide swings in dissolved oxygen (D.O.) concentrations between day and night (Figures 37 and 39) recorded by continuous monitors at Butterfield Road in 2006 and 2007. Wide D.O. swings are characteristic of high rates of photosynthesis and respiration. Elevated TKN concentrations reflect either suspended algae or refractory nitrogenous wastes. The D.O. swings at Butterfield Road were so wide as to force night-time minimums to below thresholds set for the protection of aquatic life in June of 2006 and 2007 (Figures 38 and 40). Minimum D.O. concentrations frequently fell below standards at the Fullersburg Woods site in 2006 and 2007. Several instances where the 7-day daily mean D.O. concentrations fell below water quality standards were also noted for the Butterfield Road (Figure 34) and Fullersburg Woods (Figure 35) sites in July of 2006 (Table 7). The low dissolved oxygen concentrations in July may be related to increased oxygen demand subsequent to the high productivity observed in June. That is, decaying algal cells may be exerting a demand. Note that the Fullersburg Woods site is downstream from the Butterfield Road site, and consistently experienced lower dissolved oxygen concentrations. Apparently, the algae generated in the Butterfield Road reach are exported to the Fullersburg Woods reach (defined ad hoc as the reach from the confluence with Oakbrook Creek to the Graue Mill Dam) where they senesce and exert demand on the oxygen. This assertion is supported by the observation that D.O. swings were higher at the Butterfield Road site in both years. The habitat in the Fullersburg Woods reach lacks riffles. Additionally, the Fullersburg Woods reach may be subject to an oxygen sag from combined sewer overflows or wastewater loadings. Contrast these sites with York Road, a free-flowing site where no dissolved oxygen problems were noted.

Most other chemical constituents measured in Salt Creek were within ranges typical of effluent-dominated streams having well-run treatment plants. Ammonia nitrogen, total suspended solids and biochemical oxygen demand typically did not exceed water quality standards (Figure 33); however, highly elevated ammonia concentrations exceeding limits for the prevention of chronic toxicity were noted in samples collected immediately downstream from the Bensenville WWTP at Jefferson Road (SC 24; Table 7). Though not exceeding water quality standards, measured biochemical oxygen demand (cBOD5) was generally elevated throughout the basin, probably reflecting diffuse contributions from the suburban landscape, especially algae flushed from detention ponds (Figure 45). Concentrations of total dissolved solids (TDS) exceeding water quality standards for the protection of aquatic life were noted in the headwaters of Salt Creek, especially the Arlington Branch and Baldwin Creek in Cook County (Figure 44). TKN concentrations were also highly elevated in Baldwin Creek. The source(s) of the high TDS and TKN was not identified, but appear unrelated to wastewater discharges, and likely symptomatic of high density residential development. Potential nonpoint sources of TDS include road salt, well brine, and parent geology. Identification of individual sources of TDS is a suggested avenue of further study. High TKN values are most likely attributable to phytoplankton and other seston being discharged from the numerous stormwater and other ponds either fringing or part of the tributary network to Salt Creek.

Table 7. Water quality standards exceedences noted in water quality samples collected from Salt Creek and its tributaries, 2006-2007.

Water Body		Date	Constituent	Concentration	Standard
Trib. to Salt Creek	SC02	08/16/07	TDS	1090 mg/l	OMZ[a]
Trib. to Salt Creek	SC02	11/12/07	TDS	1300 mg/l	OMZ
Salt Creek	SC04	11/07/07	TDS	1010 mg/l	OMZ
Trib. to Salt Creek	SC05	11/13/07	TDS	1070 mg/l	OMZ
Trib. to Salt Creek	SC06	11/13/07	D.O.	2.67 mg/l	Not to exceed
Salt Creek	SC07	09/20/07	TDS	1160 mg/l	OMZ
Spring Brook	SC16	11/02/07	TDS	1120 mg/l	OMZ
Addison Creek	SC24	10/15/07	NH3-N	5.09 mg/l	Chronic
Oakbrook Creek	SC36	08/30/07	TDS	1610 mg/l	OMZ
Oakbrook Creek	SC36	08/30/07	Chloride	590 mg/l	OMZ
Trib. to Salt Creek	SC45	09/24/07	TDS	1150 mg/l	OMZ
Salt Creek	SCBR	07/20-27/06	D.O.	<6.0	7-day MAVG[b]
Salt Creek	SCFW	07/14-17/06	D.O.	<6.0	7-day MAVG
Salt Creek	SCFW	06/17-07/04/07	D.O.	<6.0	7-day MAVG

[a] OMZ – Outside mixing zone
[b] 7-day MAVG – Mean daily dissolved oxygen concentration averaged over 7 days.

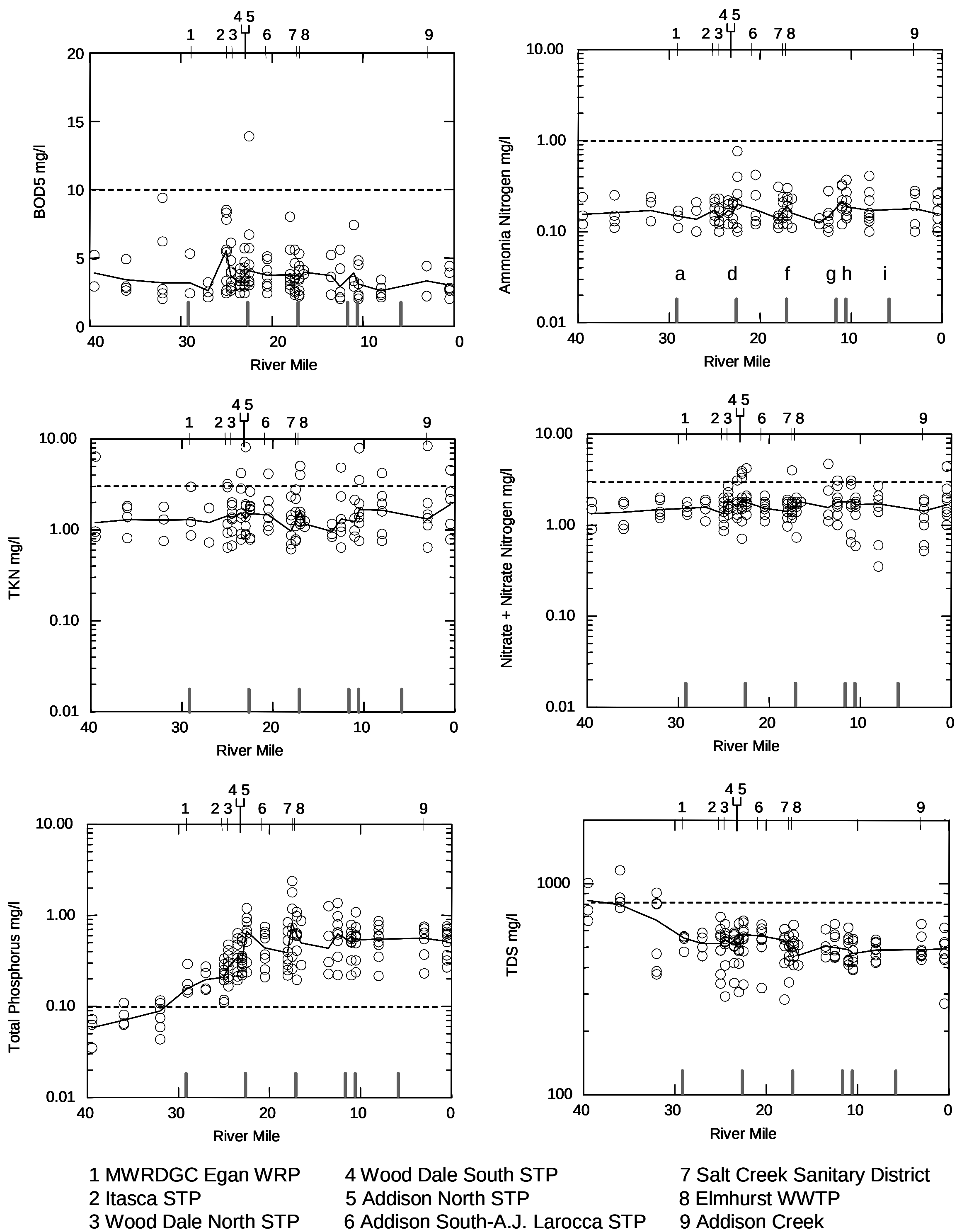


Figure 33. Concentrations of water quality parameters measured in samples collected from Salt Creek during the summer-fall low flow period in 2007. Locations of dischargers and the confluence with Addison Creek are shown along the top of each plot as a number key. Vertical bars on the x-axis show the locations of dams (letters in the ammonia plot identify the dams per Figure 11). Dashed lines in each plot show the upper range of concentrations found in unpolluted water (USEPA 2000, Ohio EPA 1999, Wetzel 1981). Solid lines shows the median values at each river mile.

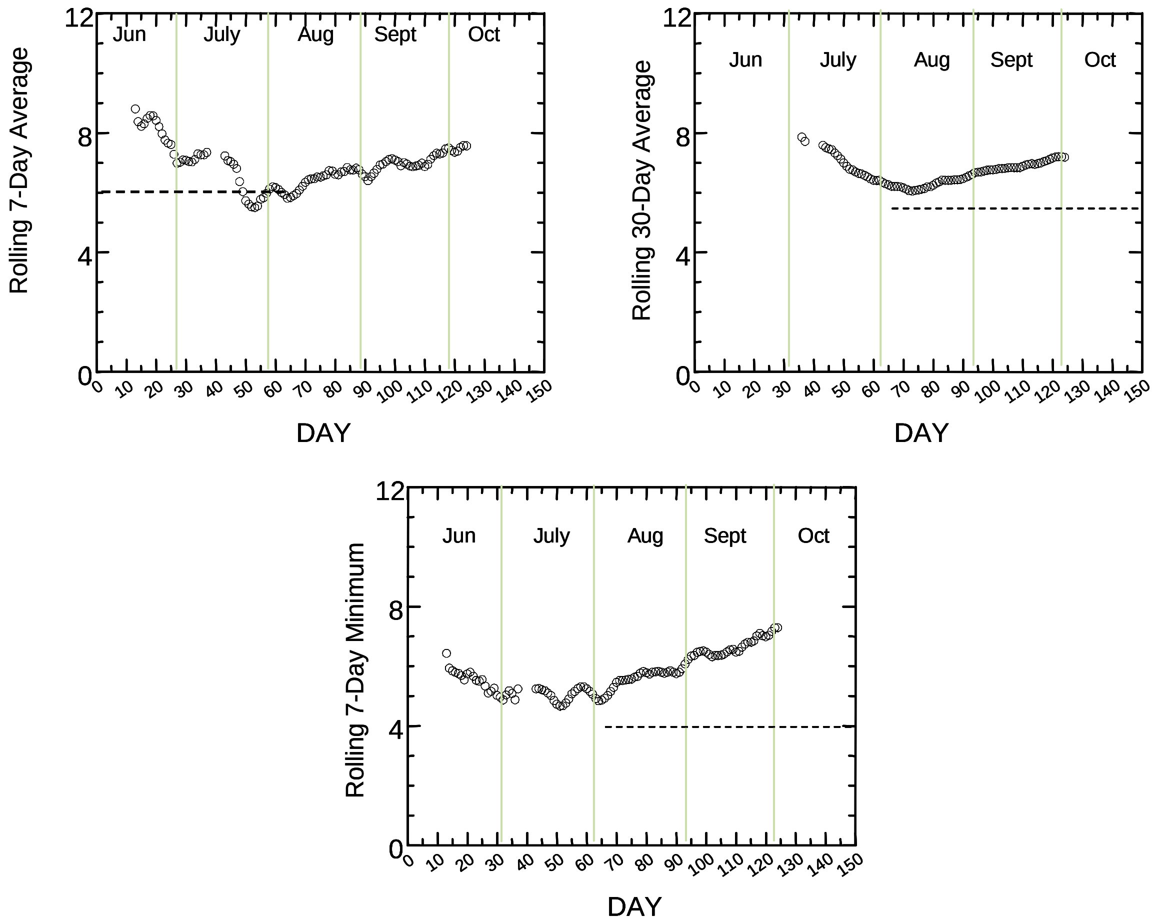


Figure 34. Results from continuous monitoring in 2006 of dissolved oxygen concentrations at the Salt Creek Butterfield Road site (RM 15.9) in relation to various water quality standards for dissolved oxygen. The dashed line in each plot shows the water quality standard corresponding to the labeled y-axis and the appropriate time period. Y-axis units are in mg/l.

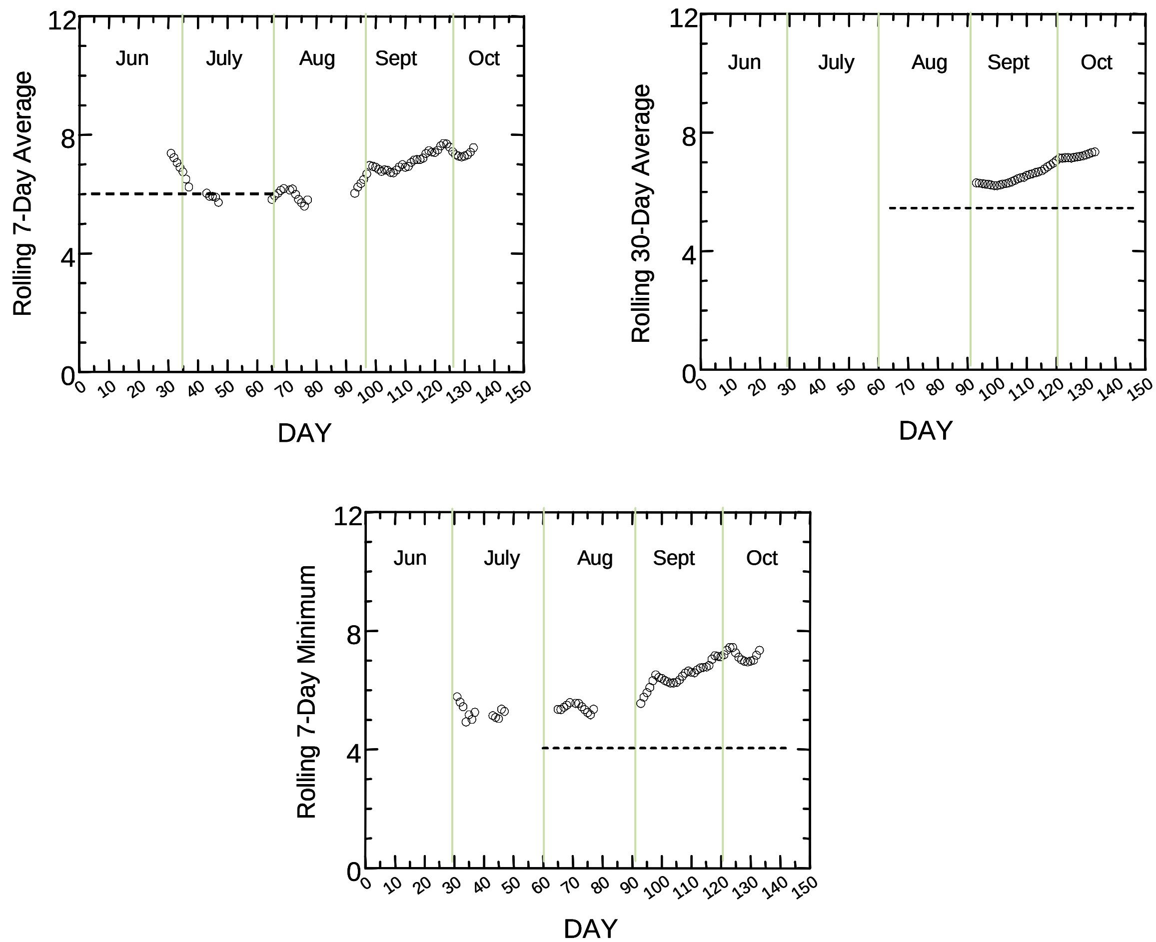


Figure 35. Results from continuous monitoring of dissolved oxygen concentrations at the Salt Creek Fullersburg Woods site (RM 11.0) in relation to various water quality standards for dissolved oxygen, 2006. The dashed line in each plot shows the water quality standard corresponding to the labeled y-axis and the appropriate time period. Y-axis units are in mg/l.

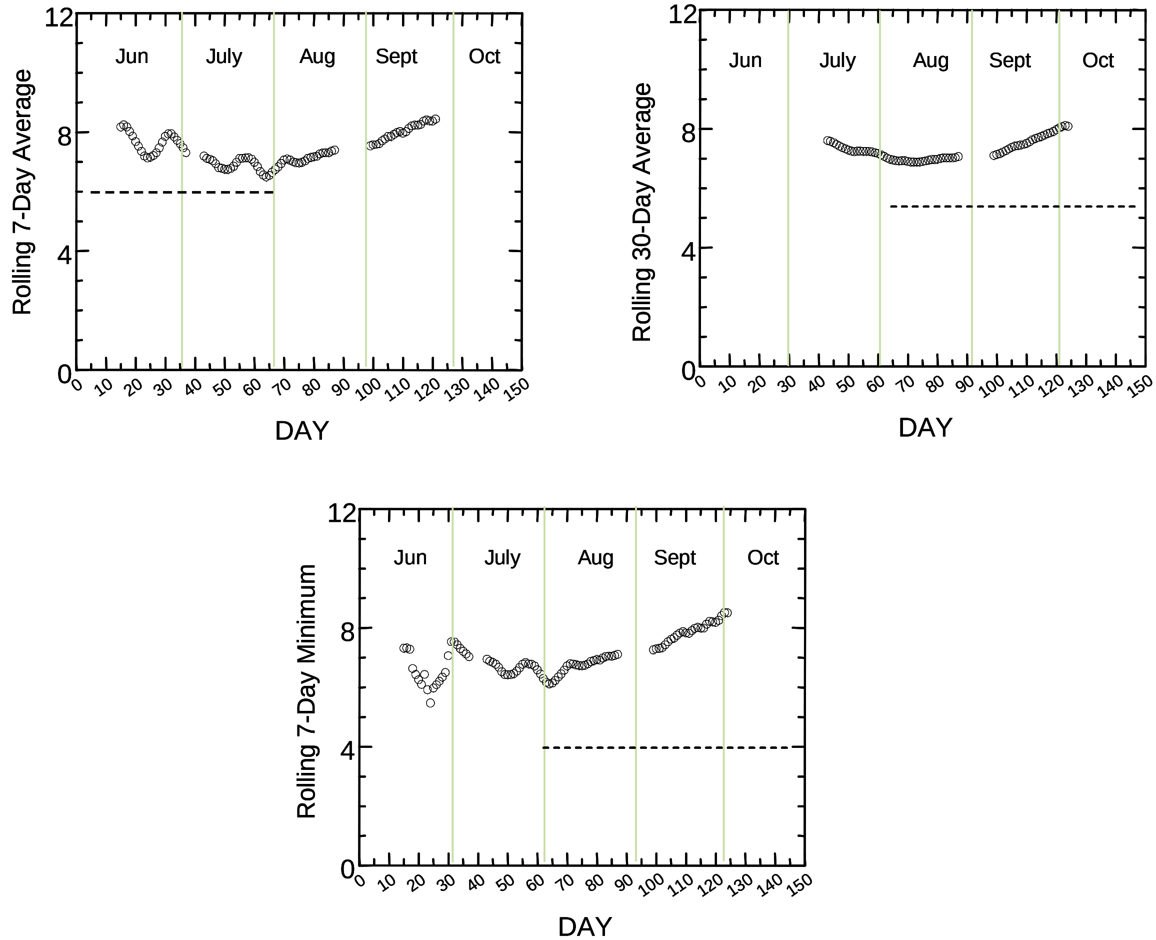


Figure 36. Results from continuous monitoring of dissolved oxygen concentrations at the Salt Creek York Road site (RM 10.50) in relation to various water quality standards for dissolved oxygen, 2006. The dashed line in each plot shows the water quality standard corresponding to the labeled y-axis and the appropriate time period. Y-axis units are in mg/l.

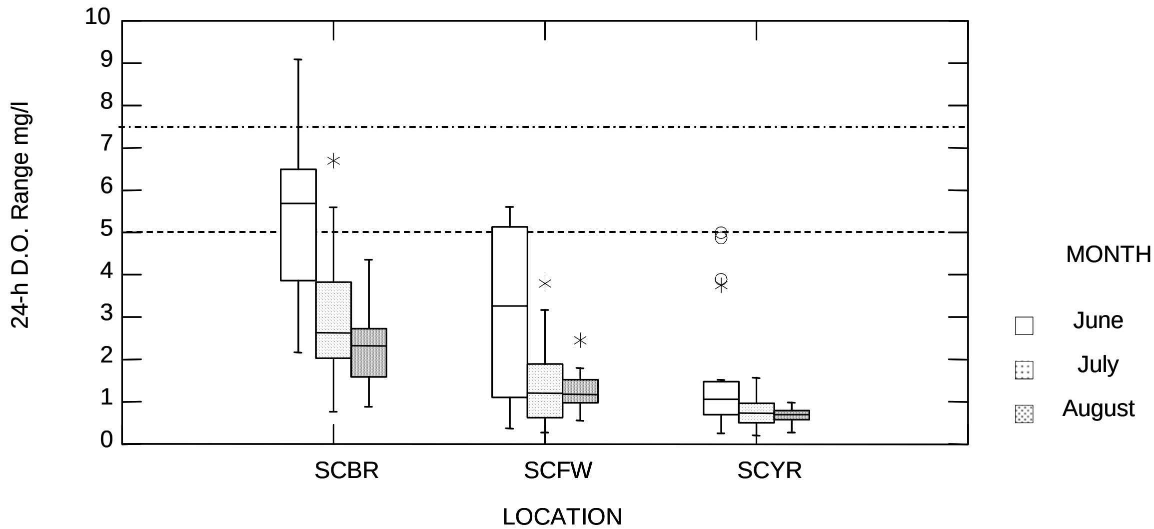
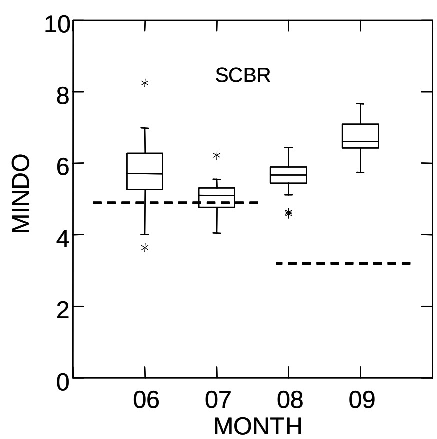
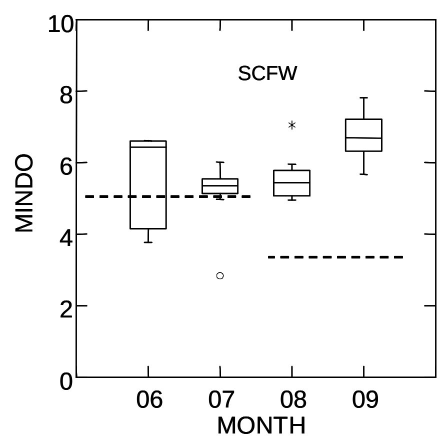


Figure 37. Distributions of the daily 24 hour range of dissolved oxygen concentrations recorded by continuous monitors in Salt Creek during 2006 plotted by location and month. Stations are: SCBR, Butterfield Road (RM 15.9); SCFW, Fullersburg Woods (RM 11.0); and SCYR, York Road (10.5). Dashed lines represent magnitudes of diel range that pose an increasing risk of stress to aquatic life.





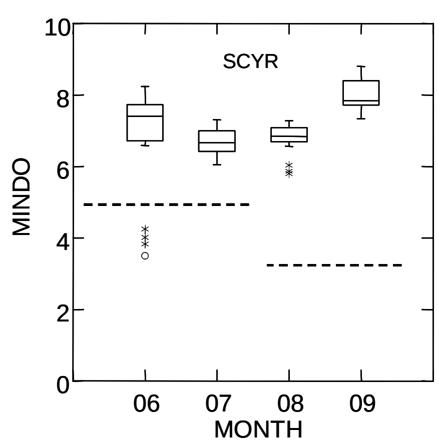


Figure 38. Distributions of daily minimum dissolved oxygen concentrations measured by continuous monitors in Salt Creek at Butterfield Road (SCBR), Fullersburg Woods (SCFW) and York Road (SCYR), 2006. Applicable water quality standards for instantaneous minimum dissolved oxygen concentrations are shown as dashed lines.

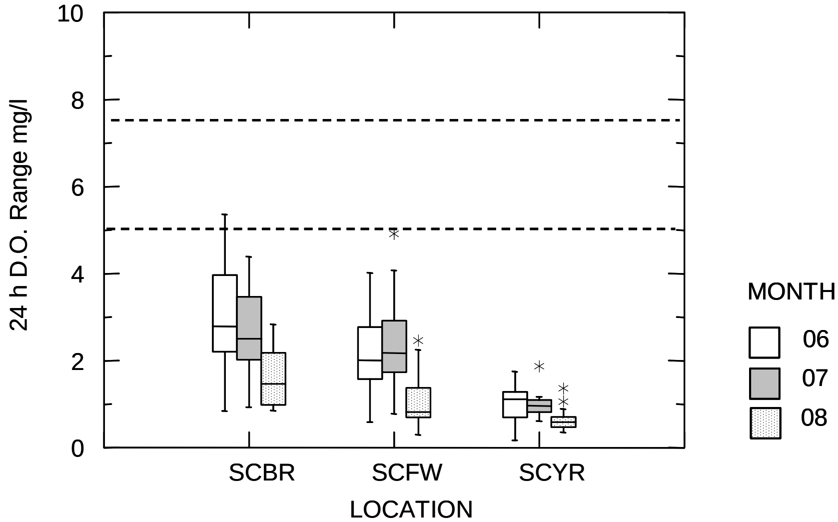


Figure 39. Distributions of the daily 24 hour range of dissolved oxygen concentrations recorded by continuous monitors in Salt Creek during 2007 plotted by location and month. Stations are: SCBR, Butterfield Road (RM 15.9); SCFW, Fullersburg Woods (RM 11.0); and SCYR, York Road (10.5). Dashed lines represent magnitudes of diel range that pose an increasing risk of stress to aquatic life.

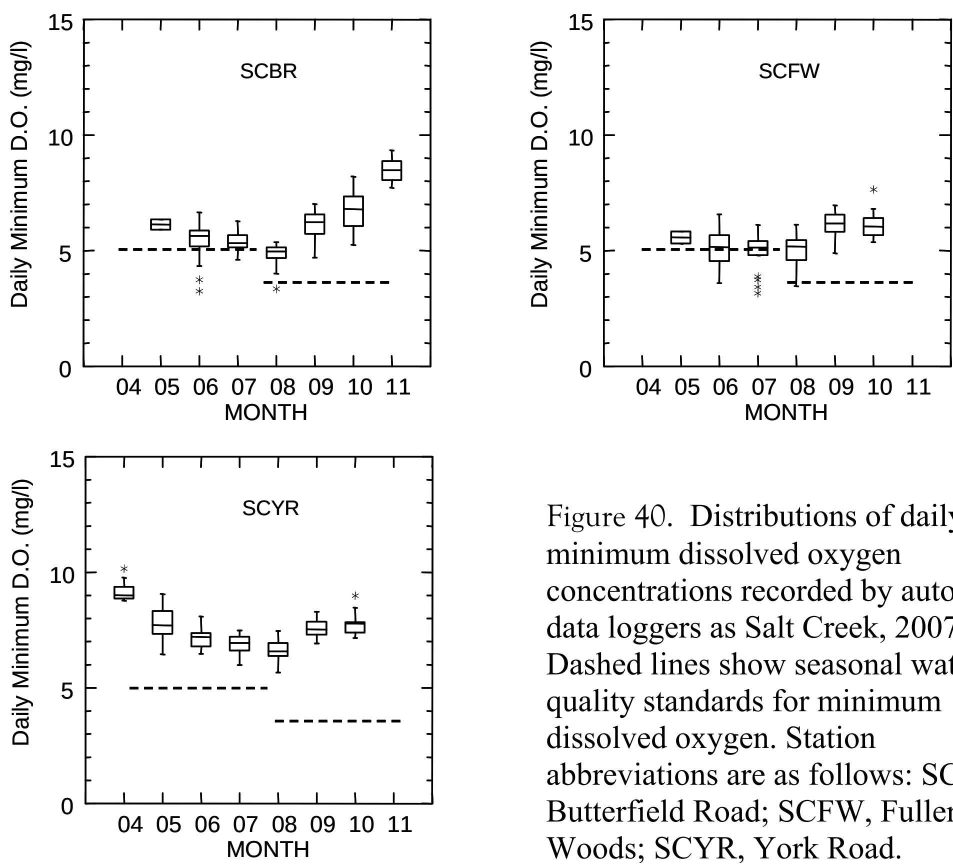


Figure 40. Distributions of daily minimum dissolved oxygen concentrations recorded by automated data loggers as Salt Creek, 2007. Dashed lines show seasonal water quality standards for minimum dissolved oxygen. Station abbreviations are as follows: SCBR, Butterfield Road; SCFW, Fullersburg Woods; SCYR, York Road.

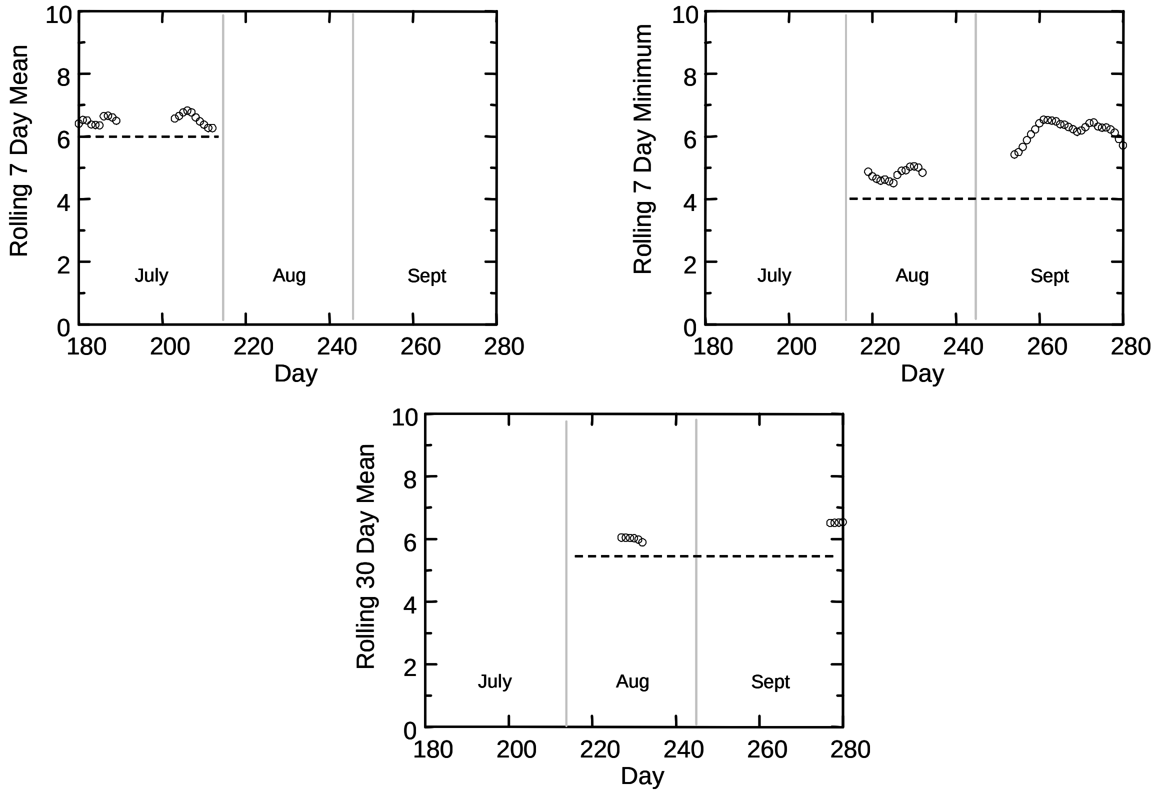


Figure 41. Results from continuous monitoring of dissolved oxygen concentrations at the Salt Creek Butterfield Road site (RM 15.9) in relation to various water quality standards for dissolved oxygen, 2007. The dashed line in each plot shows the water quality standard corresponding to the labeled y-axis and the appropriate time period. Y-axis units are in mg/l.

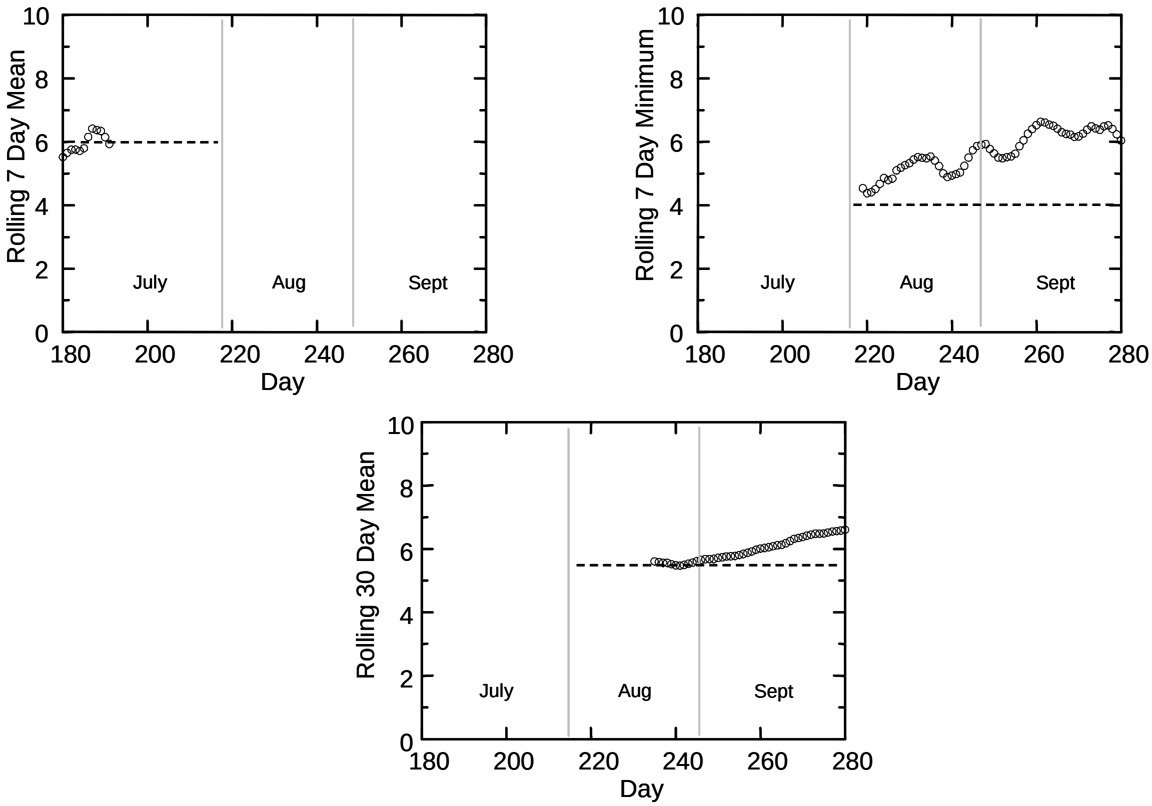


Figure 42. Results from continuous monitoring of dissolved oxygen concentrations at the Salt Creek Fullersburg Woods site (RM 11.0) in relation to various water quality standards for dissolved oxygen, 2007. The dashed line in each plot shows the water quality standard corresponding to the labeled y-axis and the appropriate time period. Y-axis units are in mg/l.

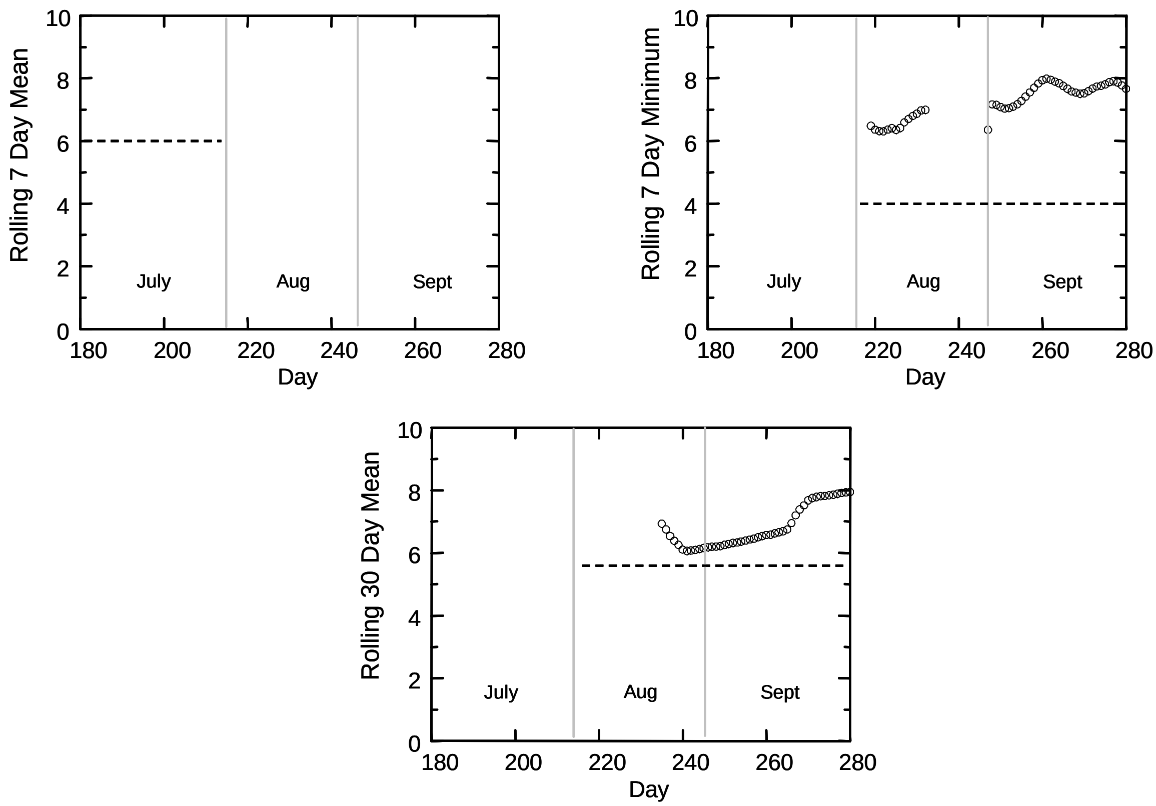


Figure 43. Results from continuous monitoring of dissolved oxygen concentrations at the Salt Creek York Road site (RM 10.50) in relation to various water quality standards for dissolved oxygen, 2007. The dashed line in each plot shows the water quality standard corresponding to the labeled y-axis and the appropriate time period. Y-axis units are in mg/l. An insufficient number of observations were made in July to compute the rolling 7 day average.

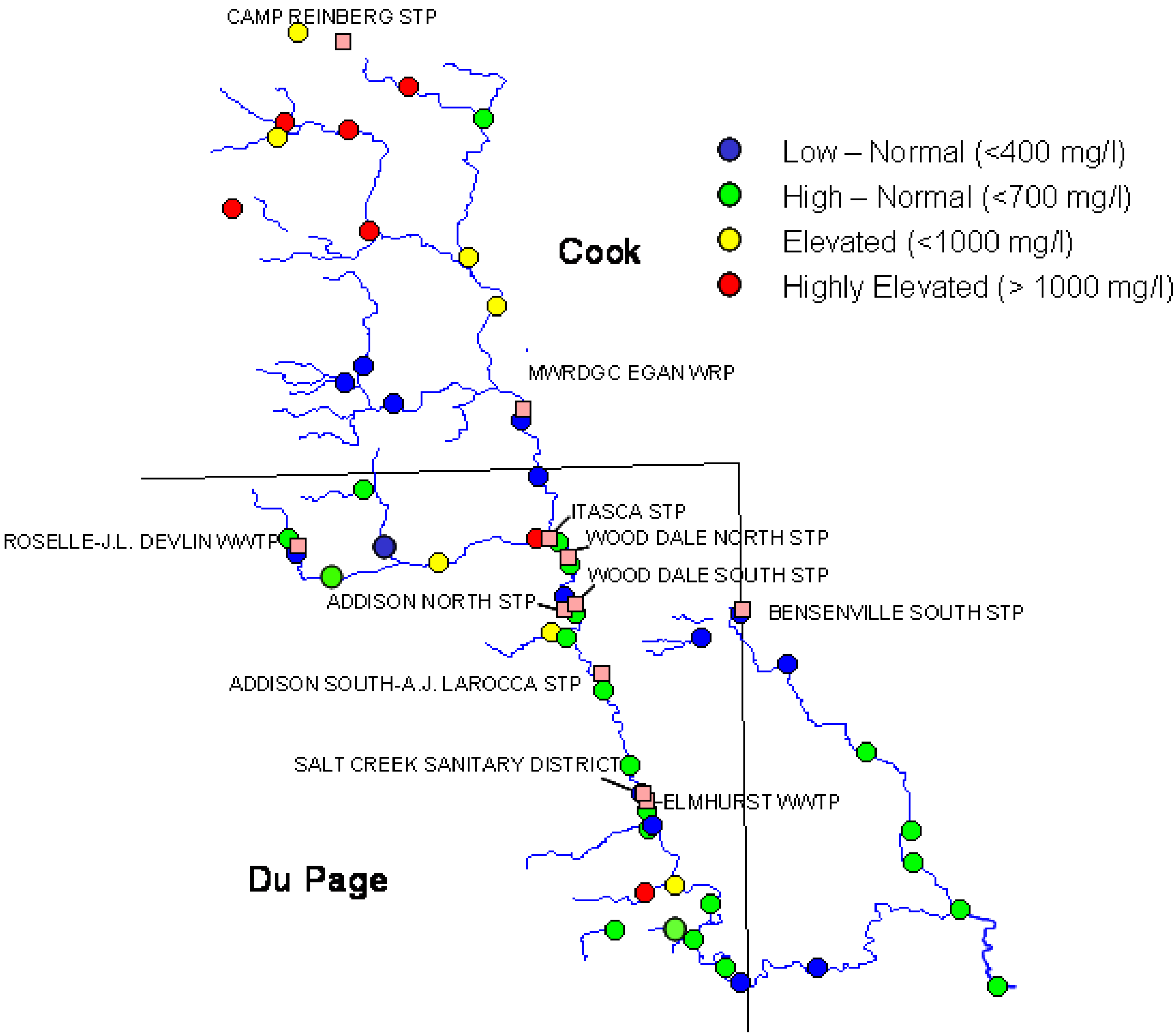


Figure 44. Mean concentrations of total dissolved solids in water quality samples collected throughout the Salt Creek watershed plotted by categorical level.

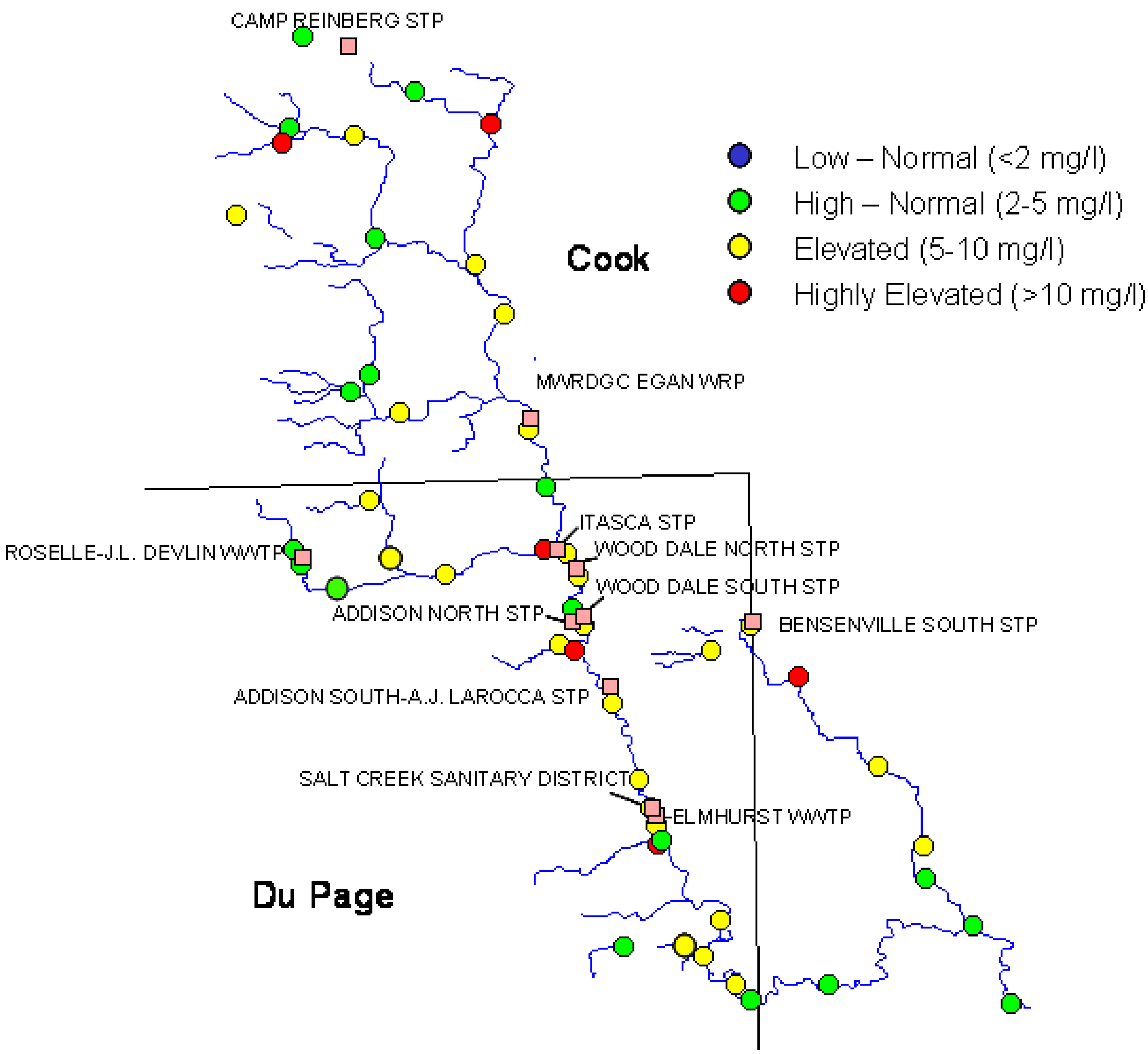


Figure 45. Mean concentrations of 5-day biological oxygen demand in water quality samples collected throughout the Salt Creek watershed plotted by categorical level.

Sediment Chemistry –Salt Creek

Sediment samples collected from Salt Creek were evaluated against guidelines compiled by McDonald et al. (2000) and the Ontario Ministry of Environment (1993) that list ranges of contaminant values by probable toxicity to aquatic life (Table 8). Specifically, threshold effects levels (TEL) are those where toxicity is initially apparent, and likely to affect only the most sensitive organisms. Probable effects levels (PEL) are those where toxicity is likely to be observed over a range of organisms. Results for metals were also compared to statistical ranges listed for Illinois lakes by Mitzelfelt (1996).

Threshold effects levels for polycyclic aromatic hydrocarbons (PAHs) were exceeded in every sample, and probable effects levels were exceeded in all but one sample. No clear geographic or longitudinal pattern in the frequency of concentrations exceeding PELs was evident (Figure 46). PAHs result from the incomplete combustion of gasoline, and are a component of stormwater in urban areas. The frequency with which PELs were exceeded suggest that PAH concentrations may be limiting to aquatic life. PELs for metal concentrations were not exceeded in any sample (Figure 47). Threshold effects levels TELs were occasionally exceeded, but the concentrations found for most metals were normal with respect to those reported by Mitzelfelt (1996). Metals in stormwater from suburban and urban landscapes originate from roofs (zinc), automobiles and pressure treated lumber (cadmium, copper, lead and zinc), and atmospheric deposition (mercury). Pesticides exceeding PELs were 4,4-DDD and 4,4-DDE, metabolites of DDT, and may be present as a result of aerial deposition from remote sources.

Table 8. Number of polycyclic aromatic hydrocarbons (PAHs), metals, polychlorinated biphenyls (PCBs), and pesticide detections found in sediment samples collected from Salt Creek and its tributaries, 2006, having concentrations that exceed threshold effects levels (TEL) listed in McDonald et al. (2000) or Ontario Ministry of Environment (1993).

		PAHs		Metals		PCBs		Pesticides	
Water Body	Site ID	TEL	PEL	TEL	PEL	TEL	PEL	TEL	PEL
Salt Creek	SC15	12	6	0	0	0	0	3	0
Salt Creek	SC23	11	2	0	0	0	0	0	0
Addison Creek	SC28	12	6	5	0	0	0	3	2
Salt Creek	SC29	12	6	2	0	0	0	3	2
Salt Creek	SC38	12	5	1	0	0	0	0	0
Salt Creek	SC39	10	2	0	0	0	0	0	0
Salt Creek	SC41	10	0	0	0	0	0	0	0
Trib. to Salt Creek	SC45	12	6	1	0	0	0	0	0
Salt Creek	SC49	11	4	3	0	0	0	3	2
Salt Creek	SC52	12	7	2	0	0	0	0	0
Salt Creek	SC53	12	6	2	0	0	0	0	0
Salt Creek	SC54	11	6	2	0	0	0	3	0

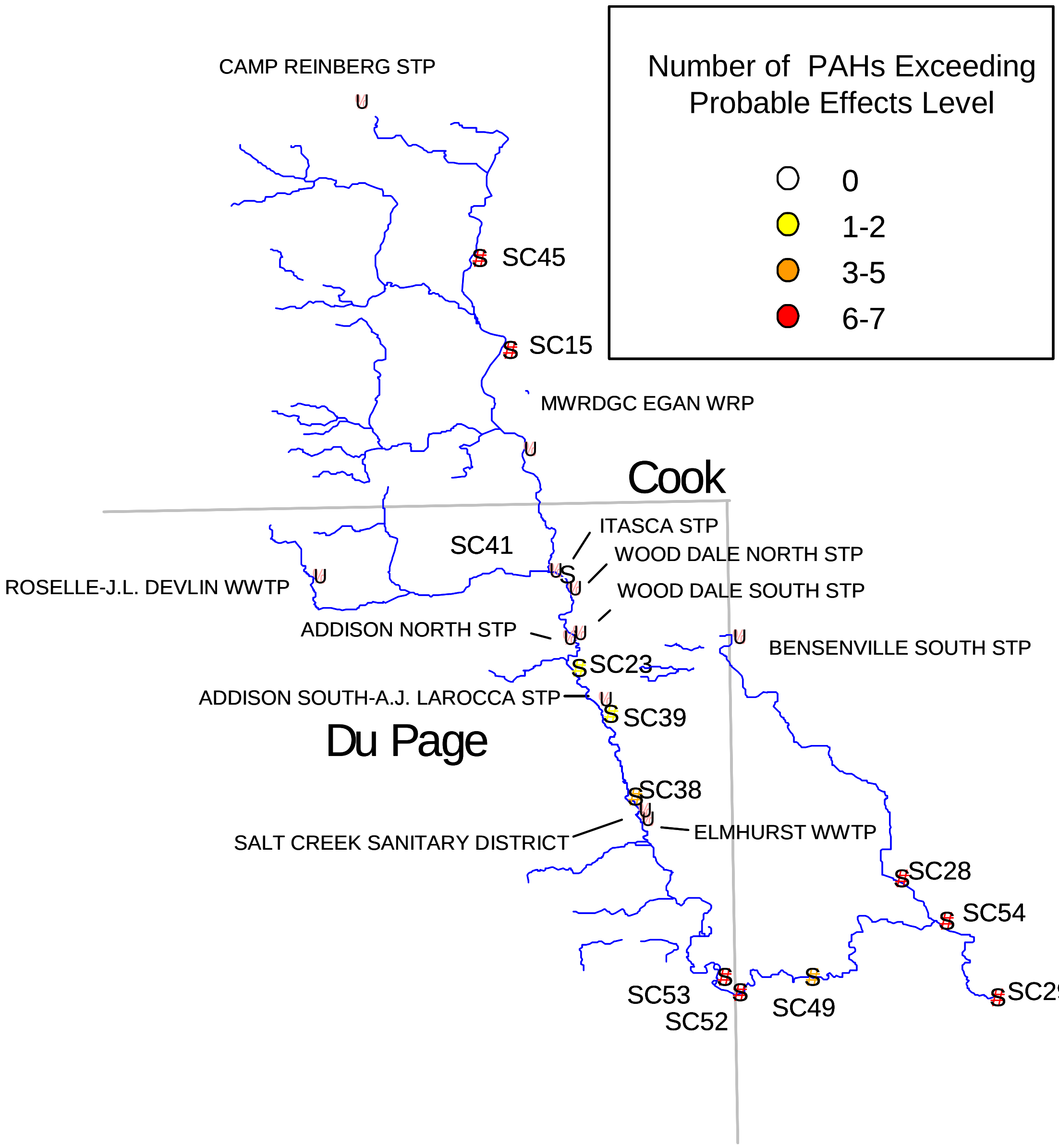


Figure 46. Locations of sediment samples collect in the Salt Creek watershed in relation to municipal wastewater dischargers. Samples are color-coded to the number of polycyclic aromatic hydrocarbons detected at concentrations exceeding levels where negative effects on aquatic organisms are probable.

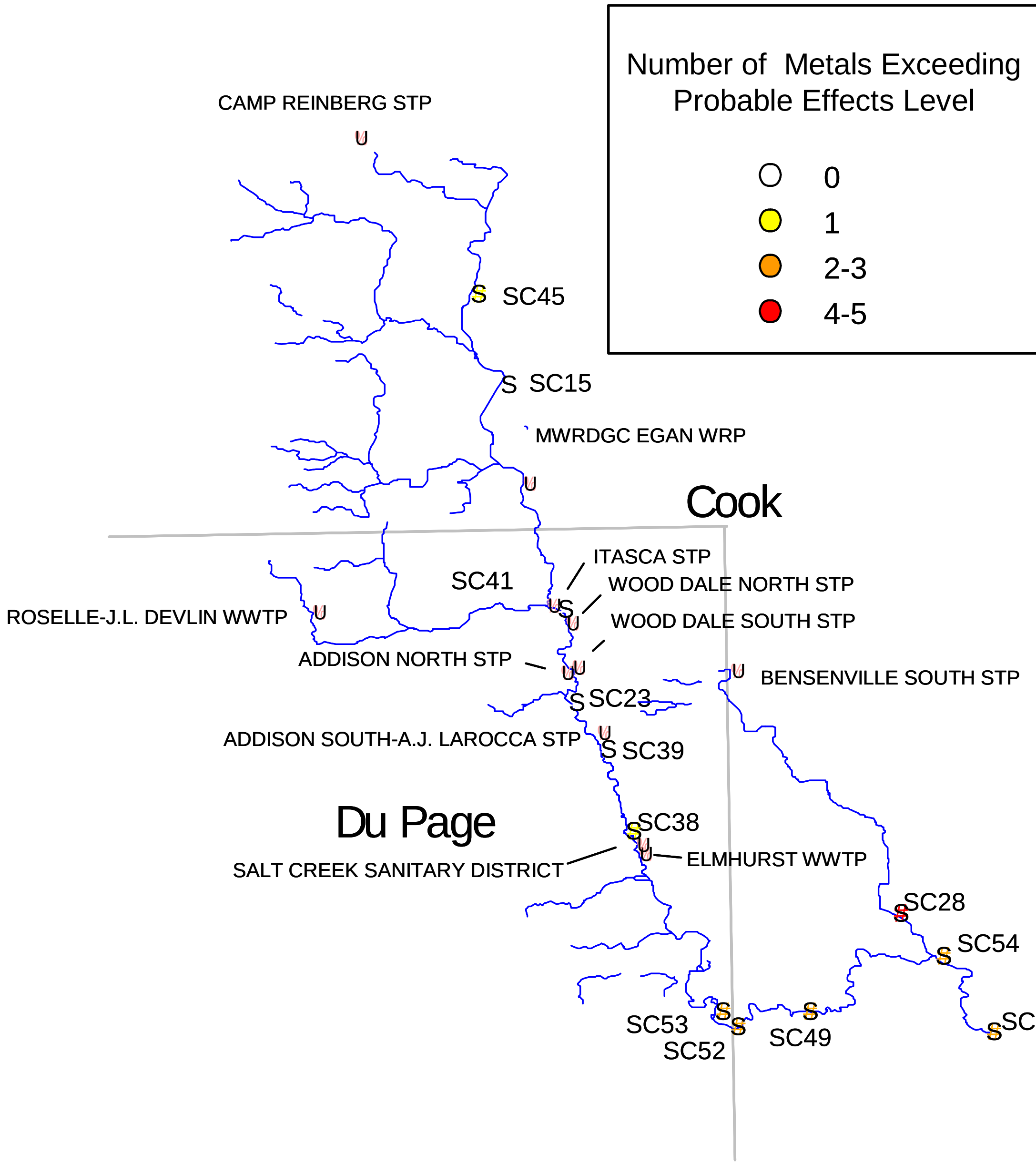


Figure 47. Locations of sediment samples collect in the Salt Creek watershed in relation to municipal wastewater dischargers. Samples are color-coded to the number of metals detected at concentrations exceeding levels where negative effects on aquatic organisms are probable.

Physical Habitat Quality of Aquatic Life – Salt Creek

The physical habitat of a stream is a strong determinant of biological quality. Streams in the glaciated Midwest, left in their natural state, typically possess riffle-pool-run sequences, high sinuosity, well developed channels with deep pools, heterogeneous substrates and cover in the form of woody debris, glacial erratics, and aquatic macrophytes. The Qualitative Habitat Evaluation Index (QHEI) categorically scores the basic components of stream habitat into ranks according to the degree to which those components are found in a natural state, or conversely, in an altered or modified state.

Summarized QHEI scores range from 12 to 100. Generally, scores greater than 75 reflect physical habitat quality that is typical for a natural, or in a modern landscape, fully recovered stream. Scores between 60 and 75 usually indicate that anthropogenic modifications or alterations are evident, though not to the degree where they are cumulatively limiting to aquatic life. Swamp streams, very small streams, and bedrock streams, however, often score in the 60–75 range in their natural state. Scores between 45 and 60 are typical of directly modified stream channels, and may or may not possess a sufficient number of attributes to support a diverse assemblage of aquatic organisms; usually not. Within this range, examining the number of habitat attributes typical of natural streams in relation to the number of attributes characteristic of stream modification can help determine whether habitat is limiting. A subset of modified attributes known to be highly influential over aquatic life are referred to as high-influence modified attributes, and are particularly useful as a diagnostic tool. These attributes are: little or no sinuosity, recent channelization, silt/muck substrates, little or no cover, and uniformly shallow depth (i.e., pools less than 40 cm deep). Streams with more than two of these high-influence attributes are not likely to support aquatic assemblages typical of natural streams.

One caveat to keep in mind is that the QHEI tends to over-rate the potential of urban streams to support aquatic life. More specifically, because urban streams are typically prevented from scouring laterally, they tend to be entrenched and have deep pools relative to their drainage areas. Also, substrates scores may be enhanced because larger substrates are all that remain following a storm surge. QHEI scores and essential habitat attributes for sites scored in the Salt Creek-DuPage River survey are listed in Table 9.

Salt Creek

QHEI scores were recorded for sites in the Salt Creek watershed where biological sampling occurred (Figure 49; Table 9). Within the Salt Creek mainstem, a longitudinal profile of QHEI scores (Figure 48) suggest that, apart from several dam pools, physical habitat quality in Salt Creek is not limiting to aquatic life, especially downstream from the Oak Meadows Golf Course (RM 22). In free-flowing sections downstream from RM 22, the habitat quality was rated in the good to excellent range, and notably influenced positively by excellent substrates. The good substrate scores were due, in part, to low-head dams acting as sediment traps on the descending limb of the hydrograph. Upstream from RM 22, modified attributes became more prevalent. The channel from the headwaters to RM 29 (Arlington Heights Road) was historically channelized and now confined by revetments. However, despite the channel modifications, the steam had recovered natural attributes, and these were not overwhelmed by the number of modified attributes at most sites. Only one site (RM 39, Quentin Road), had more than 2 high-influence modified attributes. Two modified attributes that appear frequently for the Salt Creek mainstem are fair-poor pool development and substrates embedded by fines (fine gravel, sand and silt. These attributes are related to the dams impounding water and sediment accumulating behind the dams.

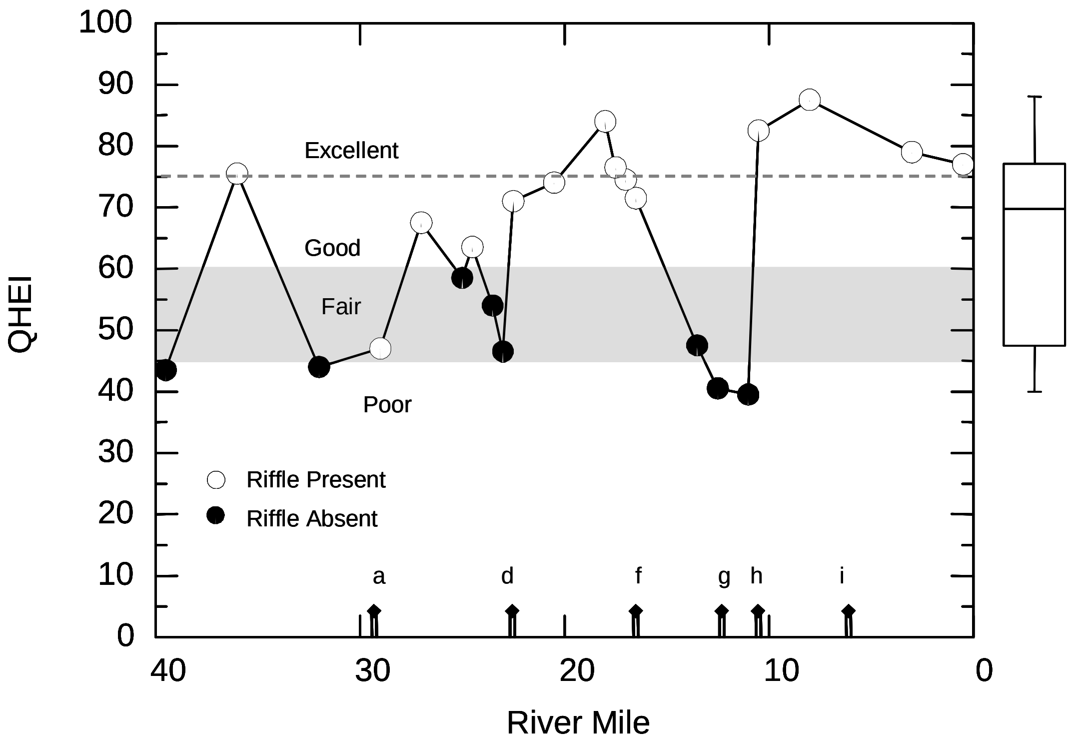


Figure 48. QHEI scores for locations sampled in the Salt Creek mainstem, 2007. The dashed line represents the boundary between excellent and good habitat quality ranges, the shaded region represents the range over which habitat quality is marginal and potentially limiting to aquatic life. Scores less than 45 represent habitats that are overwhelmingly modified in character, and therefore generally not capable of supporting aquatic assemblages consistent with Clean Water Act goals. Sites lacking riffles are noted as filled points. Dam locations are arrayed along the x-axis as diamond-tipped bars with letters corresponding to those in Figure 11. The box plot to the right of the plot shows the distribution of QHEI scores; the box bounds the 25th – 75th percentiles, the vertical line represents the median score, and whiskers show the outer range of data points.

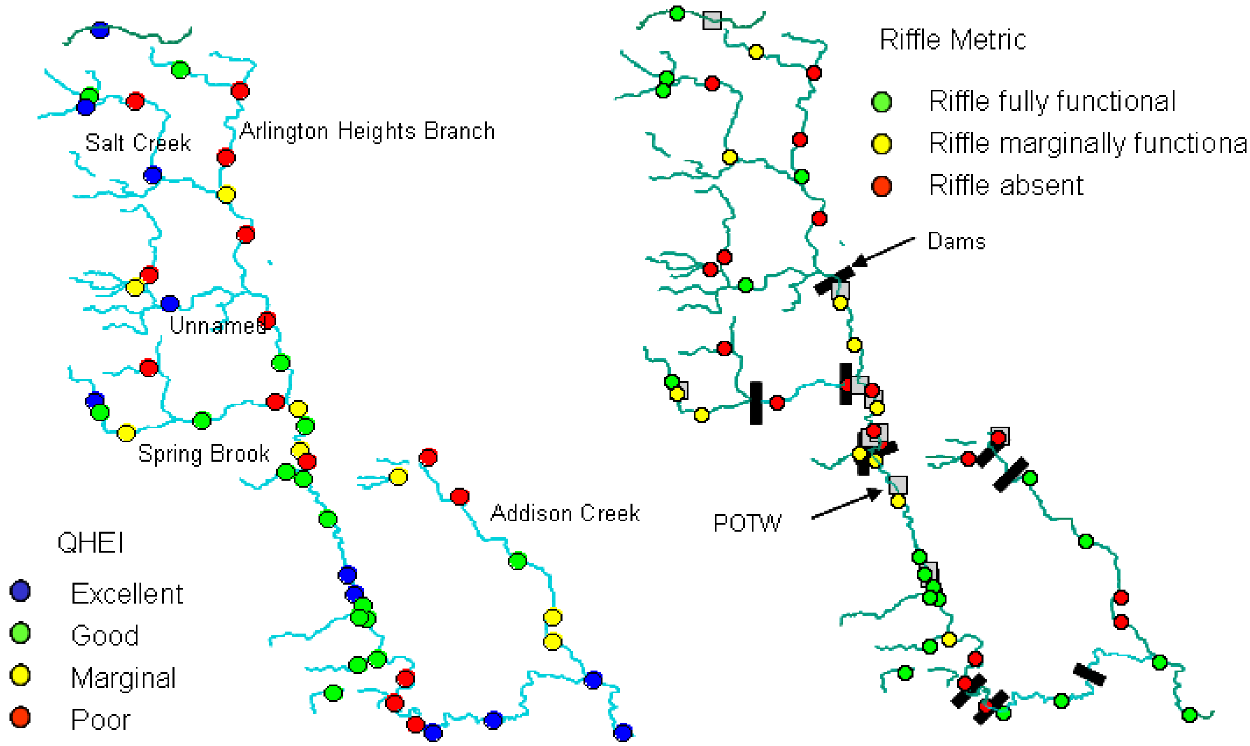


Figure 49. QHEI (left panel) and riffle metric (right panel) scores for sites sampled in the Salt Creek catchment, 2007. Scores are color-coded by narrative range.

Salt Creek Tributaries

Addison Creek and the Arlington Heights Branch had the highest number of modified attributes of the major Salt Creek tributaries (Appendix Table 1). The modifications to Addison Creek were clearly by dint of urbanization (channel incision and revetments). Similarly, the stream channel in the Arlington Heights Branch, though not actively maintained as a ditch, took on the character of a ditch by confinement and incision. The number of modified attributes in the Arlington Heights Branch and Addison Creek suggest that biological assembles typical of natural streams are not likely.

The unnamed tributary that joins Salt Creek at RM 30, and including Yeargin Creek, as a system, retained a sufficient number of natural habitat attributes to support aquatic assemblages typical for unaltered streams. All three sites sampled in this subbasin had good to excellent substrates, unmodified channels, and cover. The site at Plum Grove Road (SC12, RM 0.25), however, lacked sufficient stream flow to consistently support fish communities.

Habitat quality in Spring Brook ranged from excellent at the headwater site upstream from the Roselle-Devlin WWTP to highly degraded in the Meacham Creek tributary sampled downstream from Hawthorne Lake. As a whole, Spring Brook, though clearly showing the effects of a hardened catchment, contained sufficient numbers of natural habitat attributes, that, in the absence of other stressors, biological communities typical of the region could be supported. This assertion is supported by good to excellent substrates found at four of the six sites sampled, and fast current speeds and deep pool habitat at all sites.

Westwood Creek, Sugar Creek, Oakbrook Creek, and Ginger Creek enter Salt Creek from the west between Spring Brook and Oak Brook Park. These streams all scored similarly, and all showed stress from stormwater and suburban land uses, specifically, channel incision, low sinuosity, moderately embedded substrates and bank revetments. However, Westwood and Oakbrook Creek had positive habitat attributes, especially coarse substrates, fast current speeds, and good pool depths. Collectively, and in the absence of other stress, the habitat quality in these four streams appear capable of supporting diverse fish and macroinvertebrate communities.

Table 9. QHEI scores and metric values for sites in the Salt Creek watershed

Key
QHEI
Components

			WWH Attributes											MWH Attributes: High Influence						MWH Attributes: Moderate Influence														
River Mile	QHEI	Gradient (ft/mile)	No Channelization or Recovered	Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Substrates	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low-Normal Overall Embeddedness	Max Depth > 40 cm	Low-Normal Riffle Embeddedness	Total WWH Attributes	Channelized or No Recovery	Silt/Muck Substrates	No Sinuosity	Sparse/No Cover	Max Depth < 40 cm (WD, HW)	Total H.I. MWH Attributes	Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrates (Boat)	Hardpan Substrate Origin	Fair/Poor Development	Low Sinuosity	Only 1-2 Cover Types	Intermittent and Poor Pools	No Fast Current	High/Mod. Overall Embeddedness	High/Mod. Riffle Embeddedness	No Riffle	Total M.I. MWH Attributes	(MWH H.I.+1)/(WWH+1) Ratio	(MWH M.I.+1)/(WWH+1) Ratio
(95840) Arlington Heights Branch Salt Creek																																		
Year: 2007																																		
4.0	30.50	5.70											1	◆	◆	◆	◆		5		■			■	■			■	■	■		6	3.00	6.00
1.5	46.00	13.50		■				■			■		3	◆		◆			2		■			■	■			■	■		■	6	0.75	2.25
0.2	57.00	13.50		■				■	■		■		4	◆		◆			2					■	■				■	■		4	0.60	1.40
(95845) Baldwin Creek																																		
Year: 2007																																		
2.0	64.00	6.80	■	■			■	■	■		■		6						0		■			■					■	■		4	0.14	0.71
(95850) Salt Creek																																		
Year: 2007																																		
39.5	44.00	10.70		■				■	■		■		4	◆		◆	◆		3		■			■	■				■	■	■	6	0.80	2.00
36.0	75.50	18.00	■	■			■	■	■		■		6						0		■			■					■	■		4	0.14	0.71
32.0	44.00	7.20						■			■		2	◆					1		■		■	■	■			■	■		■	7	0.67	3.00
29.0	46.50	7.20		■					■	■	■		4	◆			◆		2					■	■					■		3	0.60	1.20
27.0	69.00	3.50		■			■	■	■	■	■		6						0	■				■						■		3	0.14	0.57
25.0	60.00	3.50		■			■	■	■		■		5						0	■	■			■					■	■	■	6	0.17	1.17
24.5	64.50	3.63		■			■	■	■		■		5						0	■	■			■					■	■		5	0.17	1.00
23.5	56.50	3.50		■			■	■	■		■		5	◆					1		■			■					■	■	■	5	0.33	1.17
23.0	46.50	3.50					■	■			■		3	◆	◆				2		■			■				■	■		■	5	0.75	2.00
22.5	71.25	3.50	■	■			■	■	■		■		6						0					■					■	■		3	0.14	0.57
20.5	75.50	5.42	■	■			■	■	■		■		6						0					■					■	■		3	0.14	0.57
18.0	84.50	5.40	■	■			■	■	■	■	■	■	8						0					■								1	0.11	0.22
17.5	78.50	5.40	■	■		■	■	■	■	■	■	■	9						0													0	0.10	0.10
17.0	74.50	5.40		■		■	■	■	■	■	■	■	8						0	■	■											2	0.11	0.33
16.5	71.75	4.61		■				■	■		■	■	5	◆					1					■	■				■			3	0.33	0.83
13.5	48.75	3.80		■				■			■		3	◆	◆				2		■			■	■			■	■		■	6	0.75	2.25
12.5	41.50	3.80						■			■		2		◆				1		■			■	■			■	■		■	6	0.67	2.67
11.0	39.50	7.20						■			■		2		◆		◆		2		■			■	■			■	■		■	6	1.00	3.00
10.5	82.50	7.20	■	■		■	■	■	■	■	■	■	9						0													0	0.10	0.10
8.0	88.00	6.00	■	■		■	■	■	■	■	■	■	9						0				■									1	0.10	0.20

Table 1. QHEI scores and metric values for sites in the Salt Creek watershed

Key QHEI Components

River Mile	QHEI	Gradient (ft/mile)	WWH Attributes: No Channelization or Recovered	Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Substrates	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low-Normal Overall Embeddedness	Max Depth > 40 cm	Low-Normal Riffle Embeddedness	Total WWH Attributes	MWH Attributes, High Influence: Channelized or No Recovery	Silt/Muck Substrates	No Sinuosity	Sparse/No Cover	Max Depth < 40 cm (WD, HW)	Total H.I. MWH Attributes	MWH Attributes, Moderate Influence: Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrates (Boat)	Hardpan Substrate Origin	Fair/Poor Development	Low Sinuosity	Only 1-2 Cover Types	Intermittent and Poor Pools	No Fast Current	High/Mod. Overall Embeddedness	High/Mod. Riffle Embeddedness	No Riffle	Total M.I. MWH Attributes	(MWH H.I.+1)/(WWH+1) Ratio	(MWH M.I.+1)/(WWH+1) Ratio
(95850) Salt Creek																																		
Year: 2007																																		
3.0	79.00	6.50	■	■				■	■	■	■		6						0					■	■					■		3	0.14	0.57
0.5	77.00	6.50		■	■	■	■	■	■	■	■	■	9						0	■												1	0.10	0.20
(95851) Trib. to Salt Creek #1																																		
Year: 2007																																		
2.0	90.00	30.00	■	■		■	■	■	■	■	■	■	9						0													0	0.10	0.10
(95852) Trib. to Salt Creek #2																																		
Year: 2007																																		
0.2	71.50	65.30	■	■		■	■	■	■	■	■	■	9						0													0	0.10	0.10
(95853) Trib. to Salt Creek #3																																		
Year: 2007																																		
0.5	79.50	37.60		■		■	■	■	■	■	■		8						0	■	■											2	0.11	0.33
(95855) Trib. to Salt Creek #5																																		
Year: 2007																																		
4.0	47.50	7.50	■				■	■			■		4						0		■			■				■	■	■	■	6	0.20	1.40
(95856) Trib. to Salt Creek #6																																		
Year: 2007																																		
2.5	85.25	8.30	■	■		■	■	■	■	■	■	■	9						0													0	0.10	0.10
(95857) Yeargin Creek																																		
Year: 2007																																		
0.2	50.25	57.60	■	■		■	■		■		■		6		◆				1		■								■	■		3	0.29	0.71
(95858) Ginger Creek																																		
Year: 2007																																		
1.5	60.75	40.90		■				■	■		■	■	5	◆		◆			2		■			■	■				■			4	0.50	1.17

Table 1. QHEI scores and metric values for sites in the Salt Creek watershed

Key QHEI Components

River Mile	QHEI	Gradient (ft/mile)	WWH Attributes: No Channelization or Recovered	Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Substrates	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low-Normal Overall Embeddedness	Max Depth > 40 cm	Low-Normal Riffle Embeddedness	Total WWH Attributes	MWH Attributes, High Influence: Channelized or No Recovery	Silt/Muck Substrates	No Sinuosity	Sparse/No Cover	Max Depth < 40 cm (WD, HW)	Total H.I. MWH Attributes	MWH Attributes, Moderate Influence: Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrates (Boat)	Hardpan Substrate Origin	Fair/Poor Development	Low Sinuosity	Only 1-2 Cover Types	Intermittent and Poor Pools	No Fast Current	High/Mod. Overall Embeddedness	High/Mod. Riffle Embeddedness	No Riffle	Total M.I. MWH Attributes	(MWH H.I.+1)/(WWH+1) Ratio	(MWH M.I.+1)/(WWH+1) Ratio
(95859) Sugar Creek																																		
Year: 2007																																		
0.2	62.50	8.10		■				■	■	■		■	5			◆		◆	2	■				■	■							3	0.50	1.00
(95860) Addison Creek																																		
Year: 2007																																		
10.5	34.50	32.30									■		1		◆	◆	◆		3		■			■	■			■	■		■	6	2.00	5.00
8.0	45.75	4.00		■					■			■	3	◆		◆	◆	◆	4		■			■	■				■			4	1.25	2.25
5.0	62.00	6.90		■		■		■	■	■	■	■	7			◆			1	■					■							2	0.25	0.50
2.5	52.50	11.10		■				■		■	■		4	◆		◆	◆		3					■	■			■			■	4	0.80	1.60
1.5	55.50	11.10		■				■			■		3	◆		◆			2		■			■	■			■	■		■	6	0.75	2.25
(95861) Trib. to Addison Creek																																		
Year: 2007																																		
0.5	51.00	16.70		■			■				■		3				◆		1	■				■				■	■	■		5	0.50	1.75
(95870) Spring Brook																																		
Year: 2007																																		
6.5	80.75	34.00		■		■	■	■	■	■	■	■	8						0	■												1	0.11	0.22
6.0	71.50	31.00		■		■		■	■	■	■		6			◆			1	■					■					■		3	0.29	0.71
4.5	56.50	54.30		■		■		■	■		■		5	◆		◆			2						■				■	■		3	0.50	1.00
2.5	60.00	8.60		■			■	■	■		■		5						0	■	■			■					■	■		5	0.17	1.00
0.2	45.50	5.30						■	■		■		3	◆	◆	◆			3		■			■	■				■		■	5	1.00	2.25
(95875) Oakbrook Creek																																		
Year: 2007																																		
0.5	64.50	57.20		■		■		■		■		■	5			◆		◆	2	■					■			■				3	0.50	1.00
0.2	67.50	20.90		■				■	■		■		4			◆			1	■	■			■	■				■	■		6	0.40	1.60
(95881) Trib. to Meacham Creek																																		
Year: 2007																																		
0.2	36.00	14.10		■				■			■		3		◆	◆	◆		3		■			■	■			■	■		■	6	1.00	2.50

Table 1. QHEI scores and metric values for sites in the Salt Creek watershed

Key QHEI Components

River Mile	QHEI	Gradient (ft/mile)	WWH Attributes: No Channelization or Recovered	Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Substrates	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low-Normal Overall Embeddedness	Max Depth > 40 cm	Low-Normal Riffle Embeddedness	**Total WWH Attributes**	MWH Attributes, High Influence: Channelized or No Recovery	Silt/Muck Substrates	No Sinuosity	Sparse/No Cover	Max Depth < 40 cm (WD, HW)	**Total H.I. MWH Attributes**	MWH Attributes, Moderate Influence: Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrates (Boat)	Hardpan Substrate Origin	Fair/Poor Development	Low Sinuosity	Only 1-2 Cover Types	Intermittent and Poor Pools	No Fast Current	High/Mod. Overall Embeddedness	High/Mod. Riffle Embeddedness	No Riffle	**Total M.I. MWH Attributes**	**(MWH H.I.+1)/(WWH+1) Ratio**	**(MWH M.I.+1)/(WWH+1) Ratio**
(95882) Westwood Creek																																		
Year: 2007																																		
0.5	61.00	28.70		■			■	■	■		■		5						0	■				■					■	■		4	0.17	0.83

Salt Creek Biological Communities – Fish

Clearly, the overwhelming limiting factor for fish in Salt Creek is stormwater from high intensity urban and suburban land uses. Stormwater is being used here to denote the suite of water quality problems associated with suburbanization: build-up and wash-off of pollutants, especially PAHs, metals, and to a lesser extent, sediment; and hydrologic and geomorphic instability imparted by stormwater, and the ensuing countermeasures used to ameliorate those effects (i.e., revetments, dams, and channelization). This limitation, so imposed on fish communities in Salt Creek, is apparent in the ubiquity of sites being rated as Limited or Restricted (Figure 50), often in the absence of any defined pollution source and occurring largely independent of habitat quality (Figure 51). That said, longitudinal variation in fish IBI and MIWb scores (Figure 52) relative to pollution sources and dams was noted along the Salt Creek mainstem in the reach where four combined sewer overflows discharge in the same mile (Figure 50; RMs 17 - 18). The scores in that reach were lower compared to those upstream, despite having some of the best stream habitat noted in Salt Creek. Fish IBI and MIWb scores immediately downstream from the Churchill Woods Dam were the highest in the creek, owning to the highly localized ameliorating effect of vigorous aeration afforded by the gradient discontinuity. Another longitudinal trend noted was an increase in the percent of fish showing external deformities, eroded fins or barbels, lesions, or tumors (DELTs) downstream from Spring Brook where Salt Creek becomes an effluent dominated stream (Figure 53). Also, the two sites sampled downstream from Spring Brook were dominated by carp, white suckers, green sunfish and bluntnose minnows a pattern that suggests organic enrichment.

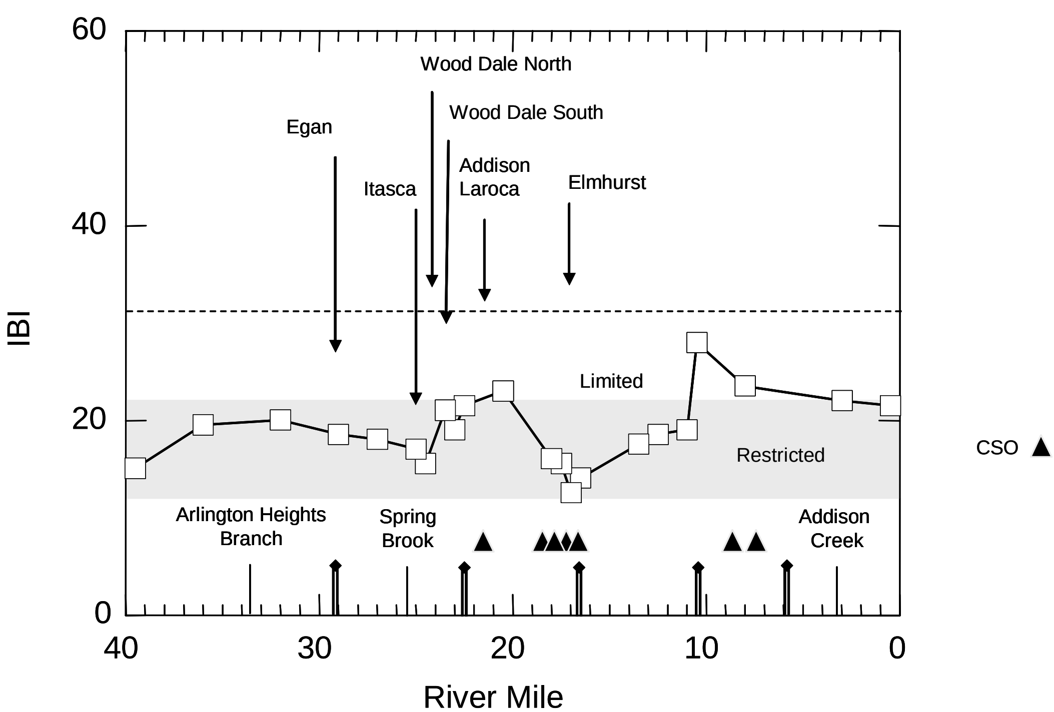


Figure 50. IBI scores for the Salt Creek mainstem, 2007, plotted by river mile (from the confluence with the Des Plaines River) in relation to municipal wastewater discharges and locations of combined sewer overflows (CSO). Dam locations are arrayed along the x-axis as diamond-tipped bars. Narrative quality ranges are noted on the plot.

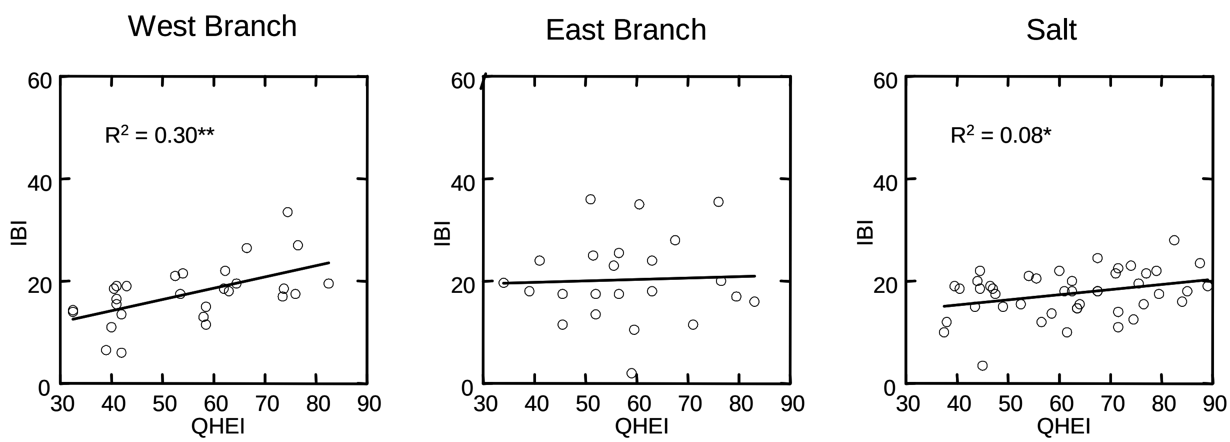


Figure 51. Scatter plots of IBI scores on QHEI scores for the West Branch, East Branch and Salt Creek basins. Coefficients of determination are noted for significant linear associations. Asterisks denote significance levels (single, 0.01<P<0.05; double P<0.01).

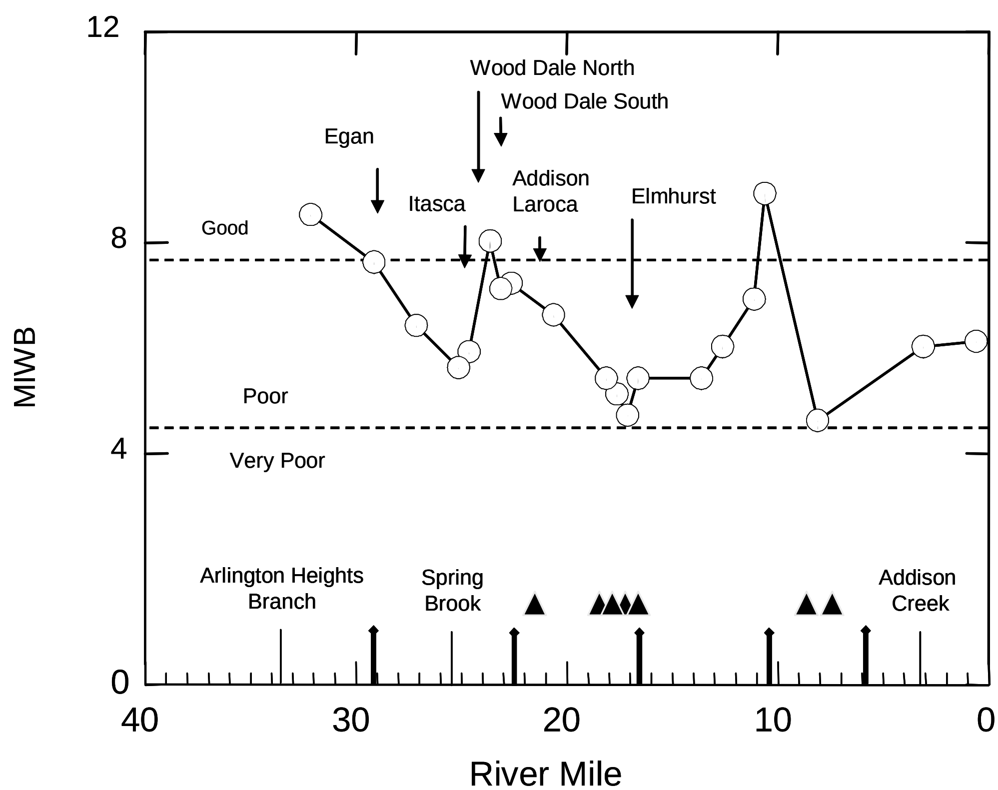


Figure 52. Modified Index of Well-being scores for fish samples collected along the Salt Creek mainstem in relation to wastewater dischargers, CSOs and dams. Miwb scores less than 4.5 are very poor, and typically indicate toxicity.

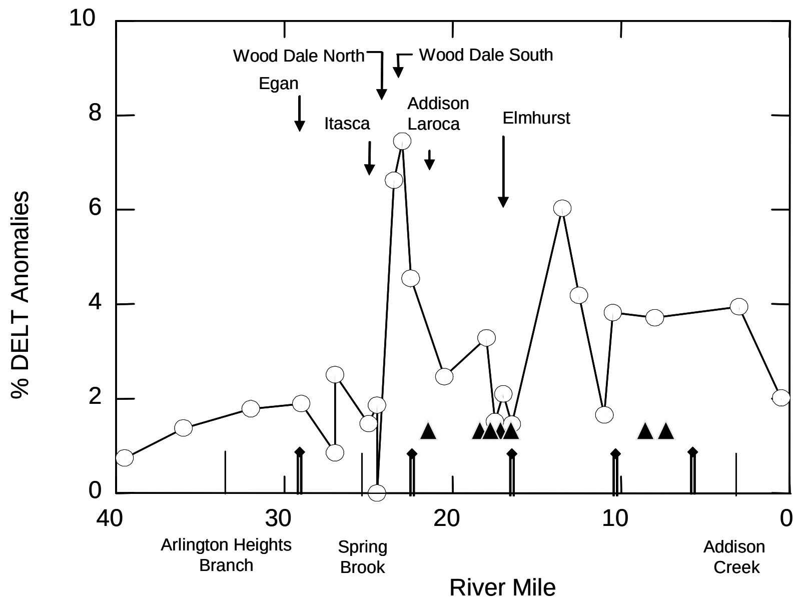


Figure 53. Percent of fish in electrofishing samples collected along the Salt Creek mainstem noted as having either deformities, eroded fins or barbels, lesions and/or tumors.

Addison Creek

The fish communities found in Addison Creek at RMs 10.5 and 8.0, and an unnamed nearby tributary to Addison sampled at South York Road, were the most rudimentary possible short of finding no fish altogether. Only very few individuals of tolerant species were found, a condition typically indicating toxicity. Toxicity was also evident in the high percent of fish showing DELT anomalies (Figure 54). Downstream from RM 8.0, the fish communities improved, and although still dominated by tolerant species, fish were numerous, and species richness increase; a condition not out of character for the heavily urbanized nature of the Addison Creek subwatershed.

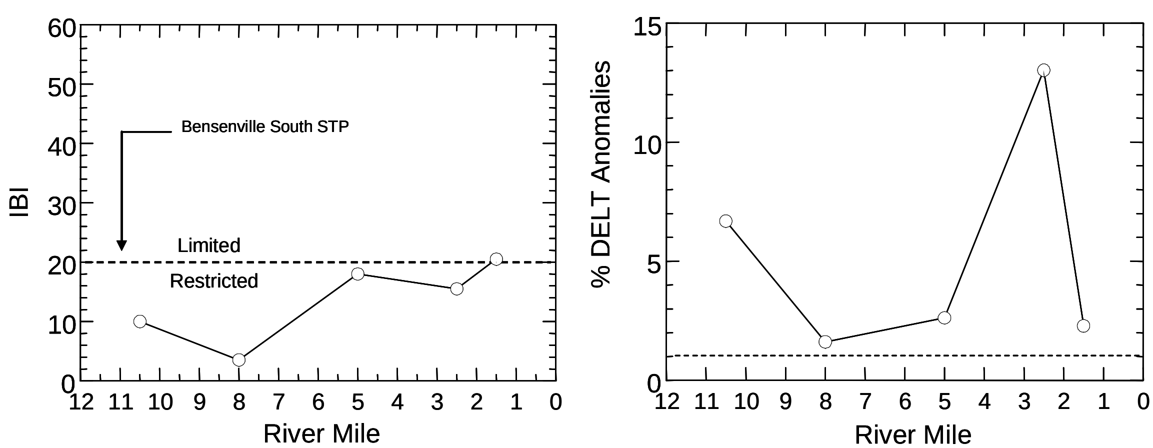


Figure 54. IBI scores and percent of fish with DELT anomalies for fish sampled from Addison Creek, 2007.

Ginger, Oakbrook, Sugar, and Westwood Creeks
Ginger Creek has been functionally reduced to a series of ponds. Three hundred eighty bluegill sunfish were collected. Oakbrook Creek was also dominated by centrarchids, but retains a vestige of lotic character as white suckers, bluntnose minnows and several creek chubs were collected. Sugar Creek, dominated by young-of-the-year carp, hosted bigmouth shiners and spotfin shiners, as well as bluntnose minnows and white suckers. Westwood Creek, again, supported an essentially lentic fish community, despite having positive habitat attributes characteristic of a functioning stream. The fauna in Westwood was dominated by juvenile centrarchids and bluntnose minnows. Clearly, all of these streams are highly degraded with respect to their fish faunas.

Spring Brook
One remnant of the stream's namesake was found at the Rohlwing Road site (RM 2.5). Bigmouth shiners were present at comparatively high relative abundances on both passes, suggesting that they are a resident population. Apart from the bigmouth shiner, the faunas in Spring Brook at RM 2.5, 4.5, 6.0 and 6.5, and as well as the Meacham Creek tributary, were dominated by species with an affinity for lentic environments: juvenile and young-of-the-year centrarchids, bullheads, blackstripe topminnow, and golden shiner. The site at the mouth of Spring Brook (RM 0.25, dst SR 53) was dominated by large carp and bluntnose minnows, likely fueled by the series of hypertrophic ponds interspersed along the creek.

Tributary to Salt Creek at RM 32.2
The three sites sampled within this subcatchment all supported several species of stream fish, albeit, white suckers, creek chubs and bluntnose minnows. And although centrarchids were very abundant, the sunfish community was composed almost entirely of juveniles and young-of-the-year as noted previously.

Arlington Heights Branch
The fish communities sampled in the Arlington Heights Branch were well represented by creek chubs, bluntnose minnows and white suckers, indicating that the fauna was generally lotic in character. Lentic species like juvenile and young-of-the-year sunfish, bullheads and blackstripe topminnows, however, were well represented, again owing to the highly modified nature of the catchment.

Salt Creek Biological Communities – Macroinvertebrates

Salt Creek

Macroinvertebrate communities in the Salt Creek mainstem scored in the poor to fair range. All sites located in dam pools scored in the poor range. No longitudinal pattern in relation to publicly owned treatment works was evident (Figure 55). A dip in the MIBI score downstream from the Egan WRP was correlated with poor habitat. Scores in the one-mile reach that receives discharge from four successive CSOs were lower relative to those upstream, and habitat quality did not factor into the decrease. The poor MIBI score from the site near the mouth of Salt Creek (SC29, RM 0.5) was not correlated with any measured water quality parameter or known discharger; an obvious case that bears further investigation.

The site sample at RM 32 (SC15) was located in Busse Woods. It scored anomalously well relative to local habitat quality (Figure 56), revealing an interesting pattern in the MIBI scores for the Salt Creek –DuPage River study as a whole. Specifically, a particular group of sites scored higher than other sites across the spectrum of habitat (Figure 57), and the commonality was that the higher-scoring sites were located in forest preserves or had atypically wide buffers, and had ponds or wetlands immediately upstream from, or adjacent to, the sampling location. When partitioned by whether a site was located on a tributary or any of the mainstems (Salt, East Branch or West Branch), the stress caused by high density suburban development is evident in the lack of response in MIBI scores to habitat quality in the tributaries. Partitioned by mainstem, a positive relationship between MIBI scores and habitat quality exists for each of the mainstems. Beyond the obvious need for stormwater management, specifically detention and treatment of first flush events, these results suggest that biological communities will respond to habitat restoration, especially in the mainstems.

The two sites sampled upstream from the Arlington Heights Branch scored in the bottom half of the Poor narrative range. Notably high TDS concentrations were measured at these sites, as well as other sites in the portion of the catchment upstream from the confluence with the Arlington Heights Branch (see Figure 44).

Arlington Heights Branch

High TDS concentrations were noted in water quality samples collected in the Arlington Heights Branch, as was the case in the adjacent headwaters of the Salt mainstem (see Figure 44). Mayflies, a family of insects particularly sensitive to high TDS, were conspicuously absent from each of the five samples collected from this subwatershed. All five sites scored in the bottom half of the poor range (Figure 58), reflecting the combined effects of stormwater, poor habitat, and high TDS.

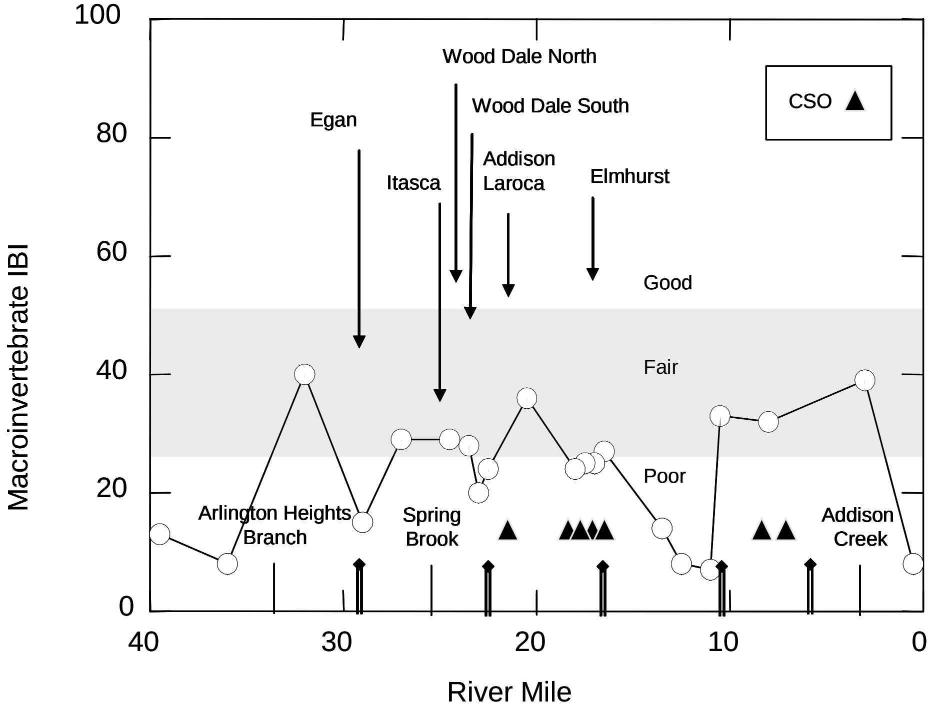


Figure 55. Macroinvertebrate IBI (MIBI) scores for the Salt Creek mainstem, 2007, plotted by river mile (from the confluence with the Des Plaines River) in relation to municipal wastewater discharges and locations of combined sewer overflows (CSO). Dam locations are arrayed along the x-axis as diamond-tipped bars. Narrative quality ranges are noted on the plot.

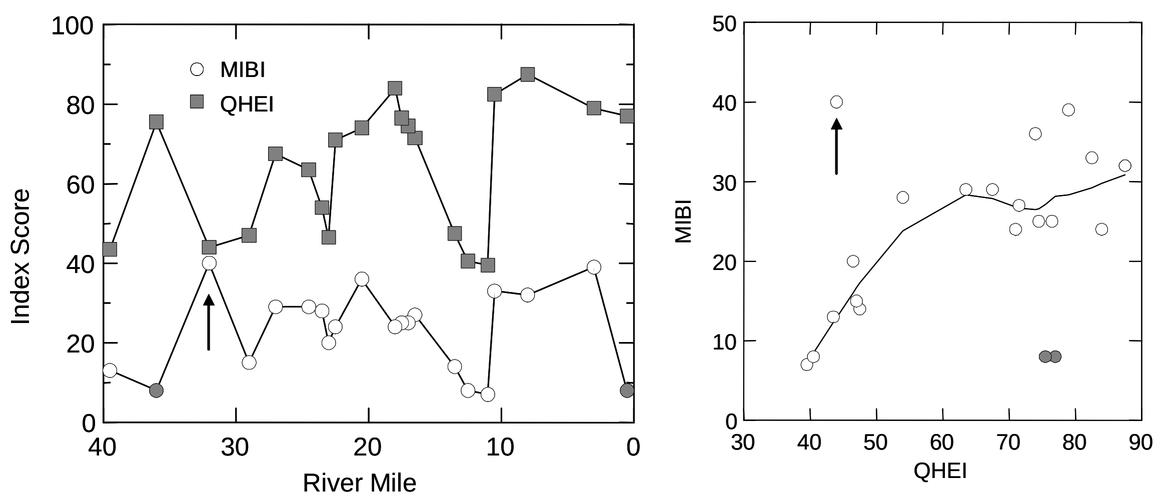


Figure 56. MIBI and QHEI scores for the Salt Creek mainstem plotted by river mile (left panel), and MIBI scores plotted as a function of QHEI scores (right panel). The arrow points to the same data point in both plots. The two MIBI scores in the right panel falling well below the fitted (LOWESS) line are shown as filled circles in both panels.

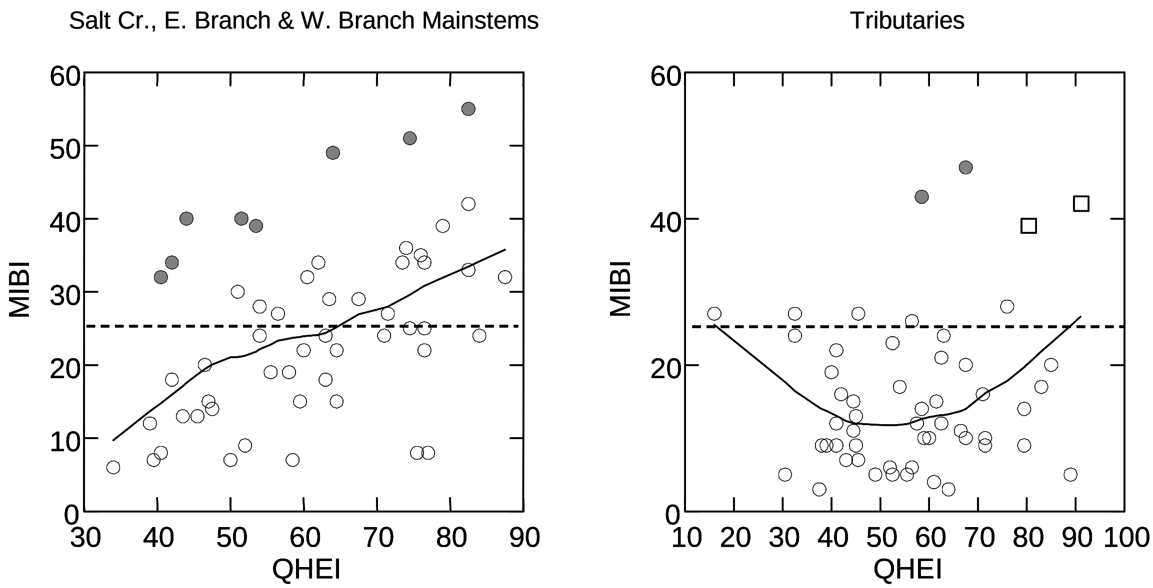


Figure 57. MIBI scores as a function of QHEI score for the Salt, East Branch and West Branch mainstems (left panel), and mainstem tributaries (right panel). Fitted lines are from LOWESS smoothing. The dashed horizontal line shows the boundary between restricted (poor) and limited (fair) narrative ranges. Filled circles indicate sites located in forest preserves, or having comparatively wide riparian buffers.

Addison Creek

Macroinvertebrate community scores at the five sites sampled in Addison Creek averaged 8.6 (+/- 7.2 SD), placing them in the bottom 10th percentile of all sites sampled. The tolerance index averaged 7.9 (+/- 1.3 SD) on a scale of 0 to 10 from pollution sensitive to pollution tolerant. These scores are indicative of toxicity. High ammonia concentrations were recorded in water quality samples collected downstream from the Bensenville South STP on two occasions, and at the Rhodes Avenue site at RM 8.0.

Ginger, Oakbrook, Sugar, and Westwood Creeks

Ginger, Oakbrook, Sugar and Westwood Creeks all had MIBI scores in the Poor range. The tolerance index for the community sampled in Ginger was 5.6, indicating that the community was not dominated by tolerant taxa, and suggesting that the low score could be forced as much by poor habitat as by stormwater. Oakbrook, Sugar and Westwood Creeks appear to be less fortunate in that their communities were dominated by tolerant organisms.

Spring Brook and Meacham Creek

MIBI scores at six locations sampled in the Spring Brook catchment averaged 12.5 (+/- 6.7 SD), falling in the lower 20th percentile of all sites sampled. Tolerance index values were also high, similar to Addison Creek, suggesting toxicity. Total dissolved solids were elevated in several of the water quality samples collected, as were cBOD5 values. The high cBOD5 values are likely the result of phytoplankton production in the series of ponds that run the length of the creek. The Roselle-Devlin WWTP discharges to the headwaters of Spring Brook, but the poor macroinvertebrate communities appeared unrelated to the plant.

Tributary to Salt Creek at RM 32.2
Macroinvertebrate communities at three sites sampled, including the one in Yeargin Creek, were rated Poor. Yeargin Creek had the poorest habitat of the three, and not uncoincidentally, the lowest MIBI score. High TDS concentrations were not recorded in any of the water quality samples collected from this sub-catchment. The poor performance appears related to stormwater and, in the case of Yeargin Creek, poor habitat.

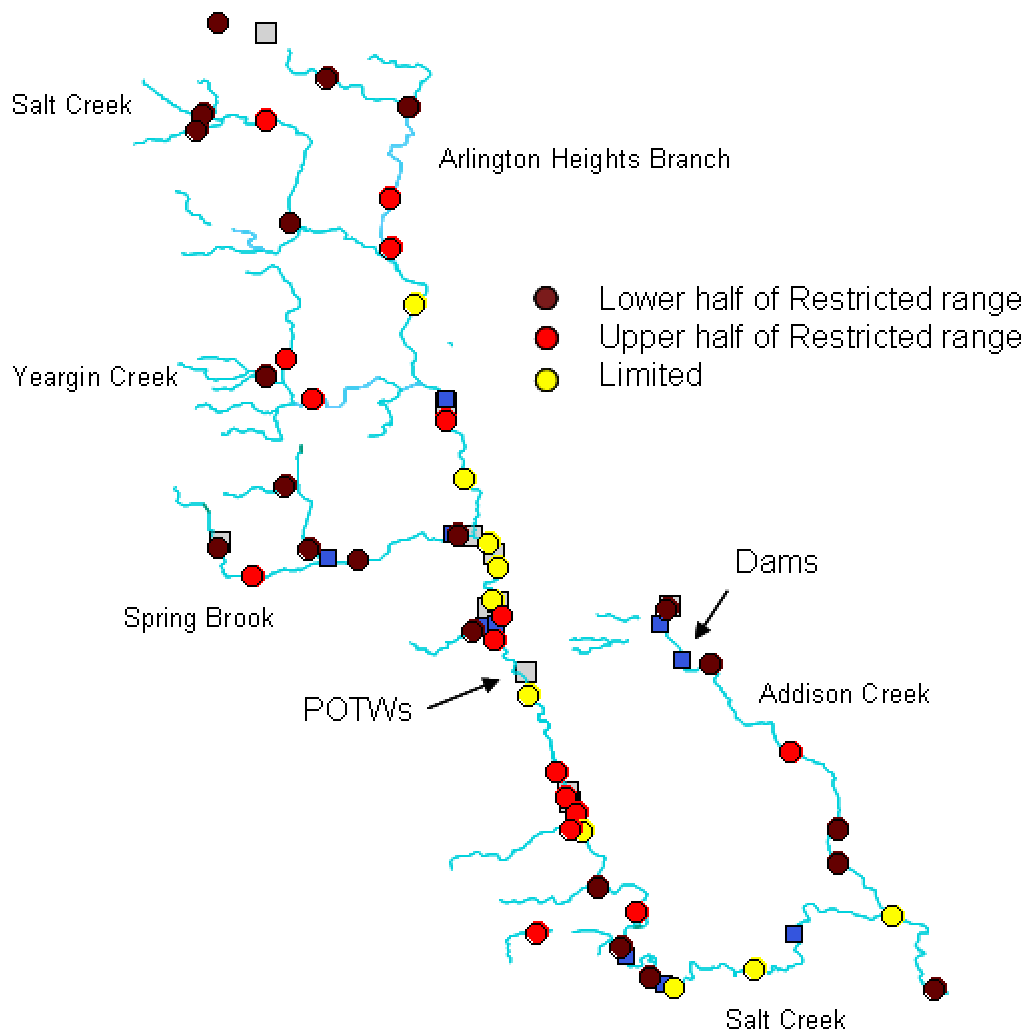


Figure 58. MIBI scores for sites sampled in the Salt Creek catchment, 2007, plotted by narrative ranges. The locations of POTWs and dams are noted.

Biological and Water Quality East Branch DuPage

The East Branch DuPage River watershed covers 81 square miles of central DuPage and northern Will Counties. The major tributaries are St. Josephs and Prentiss Creeks. The main stem of the East Branch is approximately 26 linear miles in length. The East Branch joins the West Branch of the DuPage River on the Bolingbrook municipal line to form the main stem of the DuPage River which flows into the Des Plains River. Sixteen municipalities are located within the watershed, and seven publicly owned treatment plants discharge to the East Branch, as does one combined sewer overflow. Land use in the basin is dominated by urban and residential land uses, each respectively composing 21 and 54 percent of the land area. As was noted for the Salt Creek watershed, levels that high are likely to be very important determinants of water and biological quality, and therefore, one needs to interpret the results of this study, and evaluate potential stressors against the background conditions imposed by a highly urbanized landscape.

Within that context, biological community index scores measured throughout the East Branch watershed were typically in the lower half of the quality range for both macroinvertebrates and fish, and the lowest scores for both indicators were recorded in the small headwaters (Table 9 and Figure 59). However, fish scores in the lower 11 mile reach of the East Branch mainstem scored in the upper half of the scoring range, and one macroinvertebrate score within the reach met the minimum standard for biological quality.

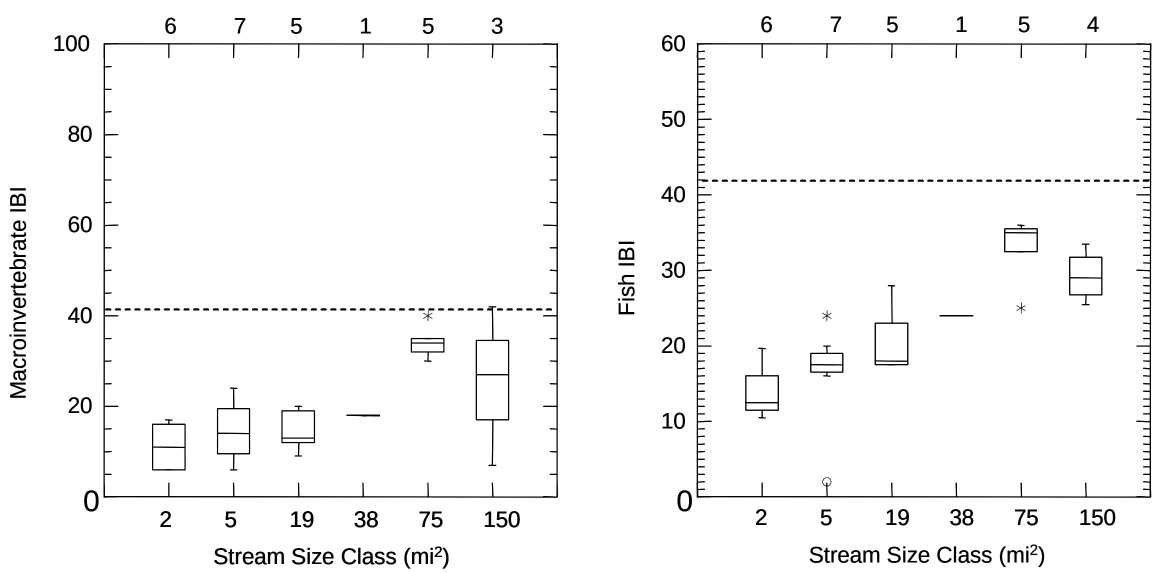


Figure 59. Distributions of macroinvertebrate and fish Index of Biotic Integrity (IBI) scores for sites sampled in 2007 from the Salt Creek basin. Results are stratified by drainage area. The dashed line in each plot shows the minimum score needed for the indicator to meet basic biological quality standards.

The influence of treated municipal effluent in the East Branch is evident in the jump in total phosphorus concentrations going from the small headwaters (i.e., < 10 mi^2) to the medium-sized streams (i.e., > 19 mi^2; Figure 60). In contrast, concentrations of ammonia-nitrogen did not increase between the size categories, and were consistently less than 1.0 mg/l, especially in the larger streams receiving treated effluent. As with Salt Creek, this suggests that treated effluent is not a major determinant of biological quality in the East Branch watershed.

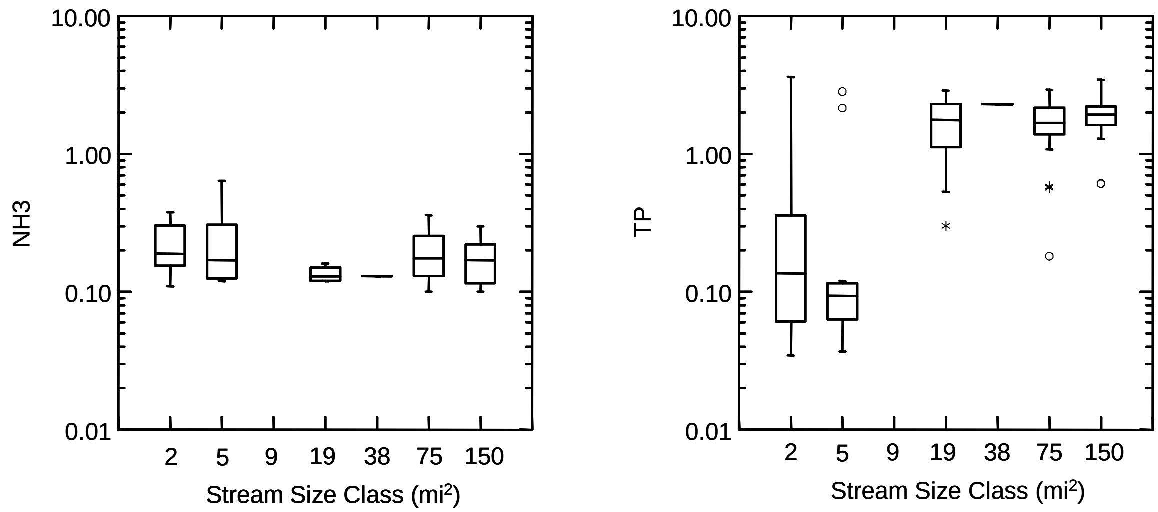


Figure 60. Concentrations (mg/l) of ammonia-nitrogen (NH3) and total phosphorus (TP) stratified by drainage area for sites sampled in the East Branch DuPage watershed, 2007.

Table 10. Attainment status of sites sampled in the East Branch DuPage drainage, 2007. Status is based on the performance of both the macroinvertebrate IBI (MIBI) and fish IBI. The Qualitative Habitat Evaluation Index (QHEI) rates habitat quality on a scale of 12 to 100, and Modified Index of Well-being (MIWb) gauges fish abundance and diversity on a scale of 0 to 12.

River Mile	Site ID	QHEI	MIBI	Fish IBI	MIWb	CWA Goal Attainment	Drain Area
95-951	Army Trail Creek						
0.25	EB24	54.0	17.0	16.0		Non	0.3
95-952	Armitage Ditch (tib to E. Branch DuPage)						
0.50	EB22	56.5	6.0	17.5		Non	2.2
95-953	Glencrest Creek						
0.50	EB15	79.5	14.0	17.0		Non	3.0
95-954	Lacey Creek						
2.00	EB14	45.5	7.0	11.5		Non	2.0
0.25	EB13	41.0	9.0	24.0		Non	4.0
95-955	Willoway Brook						
1.00	EB11	83.0	17.0	16.0		Non	3.0
95-956	22nd St. trib to E. Branch DuPage River						
1.00	EB17	71.0	16.0	11.5		Non	0.8
95-957	Rott Creek						
2.00	EB06	63.0	24.0	18.0	0.0	Non	4.0
95-980	East Branch DuPage River						
23.50	EB29	59.5	15.0	10.5		Non	2.0
23.00	EB25	34.0	6.0	19.7		Non	2.0
22.00	EB23	76.5	22.0	20.0		Non	5.0
21.00	EB26	45.5	13.0	17.5		Non	12.0
20.50	EB21	39.0	12.0	18.0		Non	14.2
19.00	EB36	52.0	9.0	17.5		Non	16.0
18.00	EB19	55.5	19.0	23.0		Non	18.0
15.50	EB30	63.0	18.0	24.0	8.0	Non	27.2
13.00	EB12	51.5	40.0	25.0	6.5	Non	50.0
11.00	EB31	51.0	30.0	36.0	8.2	Non	58.0
9.50	EB37	42.0	34.0	32.5	6.9	Non	60.1
8.50	EB32	60.5	32.0	35.0	8.5	Non	61.0

Table 10. Continued.

River Mile	Site ID	QHEI	MIBI	Fish IBI	MIWb	CWA Goal Attainment	Drain Area
95-980	East Branch DuPage River						
7.00	EB33	76.0	35.0	35.5	8.1	Non	64.0
6.00	EB35	59.0		30.0	7.7	(Non)	76.4
5.00	EB34	56.5	27.0	25.5	7.3	Non	78.0
4.00	EB39	50.0	7.0	28.0	7.2	Non	78.0
3.00	EB38	82.5	42.0	33.5	8.0	Partial	81.0

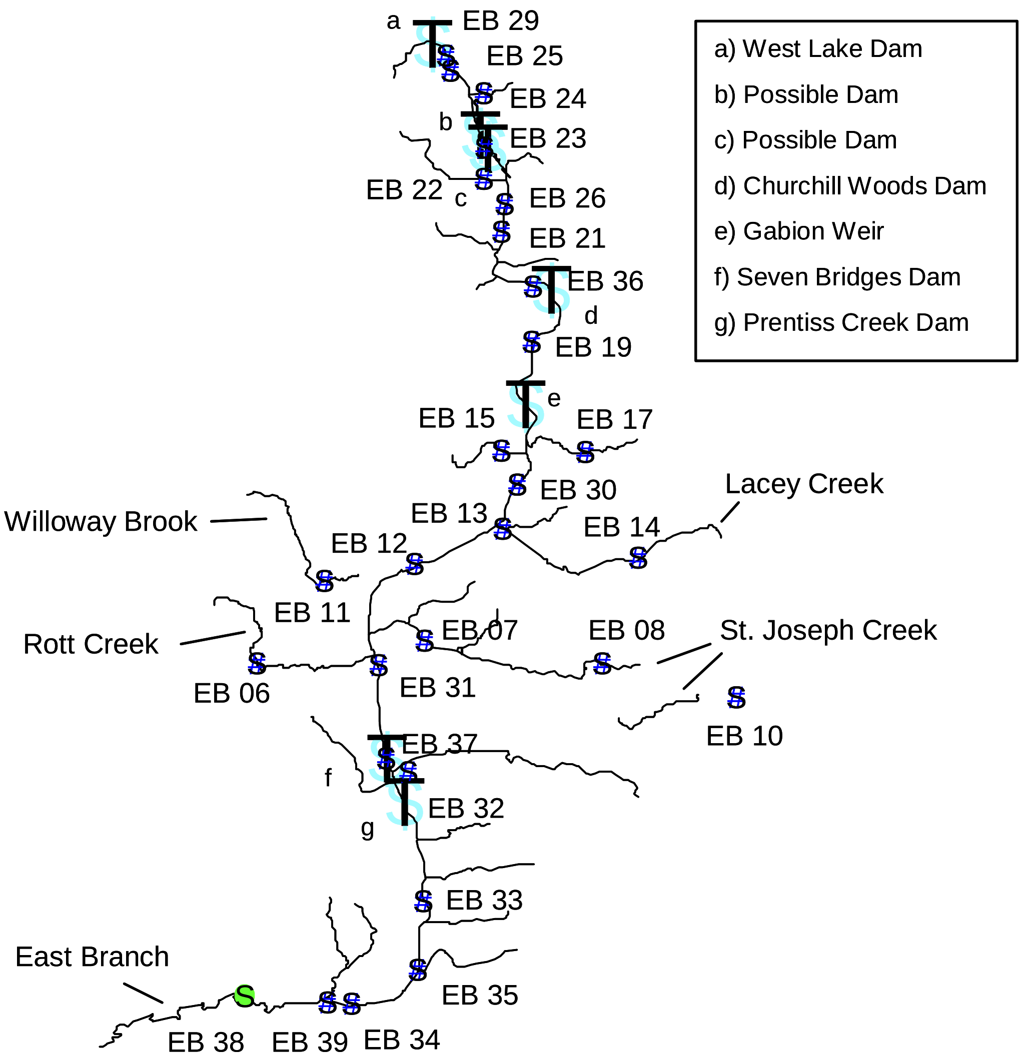


Figure 61. Locations and identification of sites sampled in the East Branch DuPage River drainage referenced in Table 10. Sites that partially meet the Illinois EPA aquatic life goal for general use waters are shaded green.

Table 11. Site location table for the East Branch DuPage River survey area (shown in Figure 61). River mile for a particular stream is measured as the distance upstream from its confluence with a receiving body. Samples are as follows: C, water chemistry; Co, water chemistry with a scan for organic pollutants; D, automated data logger for dissolved oxygen; F, fish community, M, benthic macroinvertebrate community; S, sediment chemistry.

Site ID	River Mile	Samples	Location or Landmark	Latitude	Longitude
95-951		Army Trail Creek			
EB 24	0.00	C, F, M	Dst Valley View Road	41.9317	-88.0530
95-952		Armitage Ditch			
EB 22	0.50	C, F, M	At end of Armitage Rd. off Glen Ellyn	41.9111	-88.0530
95-953		Glencrest Creek			
EB 15	0.50	C, F, M	Ust corner of Danby and Glencrest St.	41.8455	-88.0486
95-954		Lacey Creek			
EB 14	2.00	C, F, M	Ust Saratoga Ave.	41.8194	-88.0149
EB 13	0.25	C, F, M	Ust walking path culvert/ Hidden Lake F.P.	41.8268	-88.0483
95-955		Willoway Brook			
EB 11	1.00	C, F, M	Dst Leask Lane at Morton Arboretum	41.8141	-88.0923
95-956		22nd St. trib to EB DuPage			
EB 17	1.00	C, F, M	Dst Finley Ave.	41.8451	-88.0280
95-957		Rott Creek			
EB 06	2.00	C, F, M	Footbridge at end of Wellington Ave (Apartments)	41.7940	-88.1089
95-980		East Branch DuPage River			
EB 29	23.50	C, F, M	Glen Ellyn Drive and Byron Ave.	41.9409	-88.0622
EB 25	23.00	C, D, F, M	EBAT, Brookdale Ave. bridge	41.9373	-88.0613
EB 23	22.00	C, F, M, S	At end of Fullerton Ave. on East Branch F.P.	41.9187	-88.0527
EB 26	21.00	C, F, M, S	Ust North Ave.	41.9049	-88.0479
EB 21	20.50	C, F, M, S	Lyon St. Apts. Parking lot	41.8983	-88.0486
EBSC	20.00	D	EBSC, St. Charles Road	41.8903	-88.0507
EB 36	19.00	C, D, F, M	EBCW, Churchill Woods impoundment	41.8851	-88.0411
EB 19	18.00	C, F, M	At end of Roslyn Road	41.8719	-88.0415
EB 30	15.50	Co, D, F, S	Behind school yard at end of 22nd St.	48.2110	-88.0422
EBBR	14.30	D	EBBR, Butterfield Road	41.8315	-88.0532
EBHL	14.00	D	EBHL, Hidden Lake Forest Preserve	41.8257	-88.0725
EB 12	13.00	C, F, M, S	Ust Park Blvd. at entrance to Morton Arboretum	41.8182	-88.0702
EB 31	11.00	Co, F, M, S	Ust Short St. bridge	41.7936	-88.0790

Table 11. Continued.

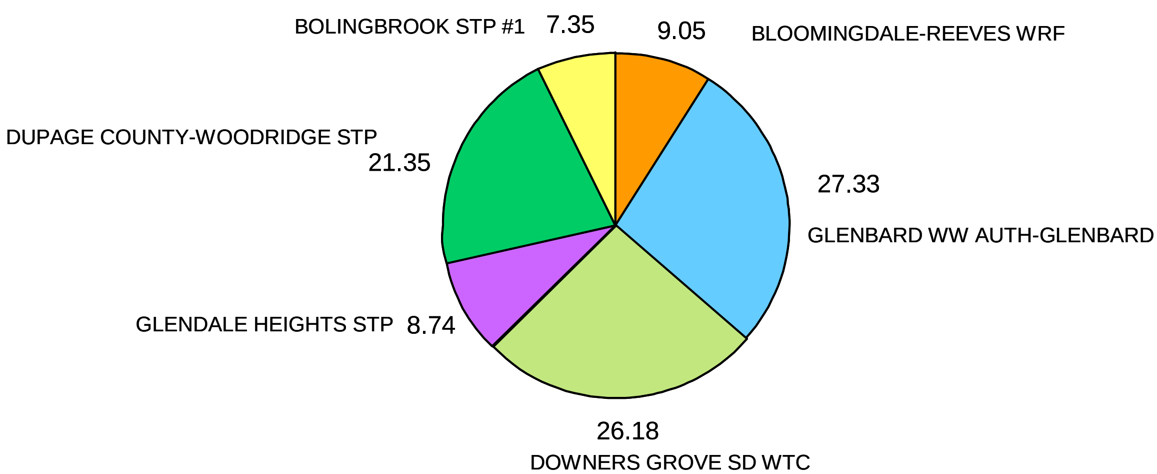
Site ID	River Mile	Samples	Location or Landmark	Latitude	Longitude
EB 33	7.00	Co, F, M, S	Ust footbridge on Green Valley F.P.	41.7367	-88.0678
EB 37	9.50	F, M	Ust footbridge at 7 Bridges GC	41.7711	-88.0773
EB 32	8.50	Co, D, F, M, S	EBHR, Ust Hobson Rd in Green Valley F.P,	41.7680	-88.0716
EB 35	6.00	Co, F, S	Ust Royce Ave	41.7202	-88.0695
EB 34	5.00	C, F, M, S	Ust Trout Farm canoe launch	41.7121	-88.0856
EB 39	4.00	F, M	Dst second large mine discharge	41.7123	-88.0916
EB 38	3.00	F, M	DuPage River Park off Naperville/Royce Rd	41.7139	-88.1118
95-987		St. Joseph Creek			
EB 10	6.00	C, F, M	Deer Park Blvd. adjacent to 56th St.	41.7858	-87.9906
EB 08	4.00	C, F, M	Dst Jacquelyn Drive in park	41.7939	-88.0239
EB 07	1.00	C, F, M, S	St. Joseph St. at St. Joseph condominiums	41.7998	-88.0675

East Branch Pollutant Loadings

The East Branch DuPage River is an effluent dominated stream during the summer base-flow period of July through October. For example, during September, 2007, effluent composed approximately 76 percent of the flow in the river. Effluent quality data from major dischargers in the East Branch watershed (Table 11) were evaluated against permit limits to gauge the relative performance of each plant, especially with respect to plant flows (the amount of effluent leaving the plant) relative to treatment capacity, and concentrations of several key effluent constituents: bio-chemical oxygen demand (cBOD5), total suspended solids (TSS) and ammonia nitrogen (NH3-N).

Table 12. Publicly owned sewage treatment plants that discharge to the East Branch DuPage River watershed. DAF is design average flow, DMF is design maximum flow. The accompanying figure shows the relative contribution as a percent of each plant to the average effluent volume for September, 2007.

Npid	Fnms	DAF MGD	DMF MGD	Receiving Stream	Longitude	Latitude
IL0021130	Bloomingdale-Reeves WRF	3.45	8.625	East Branch	-88.0528	41.9375
IL0028967	Glendale Heights STP	5.26	10.52	East Branch	-88.0506	41.9033
IL0022741	Glenbard WW Authority-Lombard CTF	NA	58	East Branch	-88.0367	41.8817
IL0021547	Glenbard WW Authority-Glenbard STP	16.02	47	East Branch	-88.0436	41.8469
IL0028380	Downers Grove Sd WTC	11	22	East Branch	-88.0808	41.7961
IL0031844	Dupage County-Woodridge STP	12	28.6	East Branch	-88.0786	41.7350
IL0032689	Bolingbrook STP#1	2.04	4.51	East Branch	-88.0714	41.7172



BOLINGBROOK STP #1 [IL0032689] The Bolingbrook STP discharges to the East Branch DuPage River. The 7-day, 10-year low flow for the East Branch at the discharge point is 28 cfs. The design average flow (DAF) for the treatment facility is 2.04 million gallons per day (MGD) and the design maximum flow (DMF) for the facility is 4.51 MGD. Treatment consists of an excess flow 5.3 MG capacity lagoon, two rotary screens, influent magnetic flow meter, two rectangular primary tanks, seven aeration tanks operated in the single stage activated sludge mode, two final 55 feet diameter circular clarifiers, an effluent flow measurement facility, effluent disinfection and dechlorination facilities, a gravity belt sludge thickener and three aerobic digestion/sludge storage tanks.

Effluent data reported between 2004 and 2007 shows that, with few exceptions, treatment efficiency was high and applicable permit limits were met (Figures 62 and 63). However, effluent flows and effluent concentrations of cBOD5 trended higher in 2007. Coincidentally, 2007 had the most reported excess flows (11 of 31) of the four year period (Figure 64).

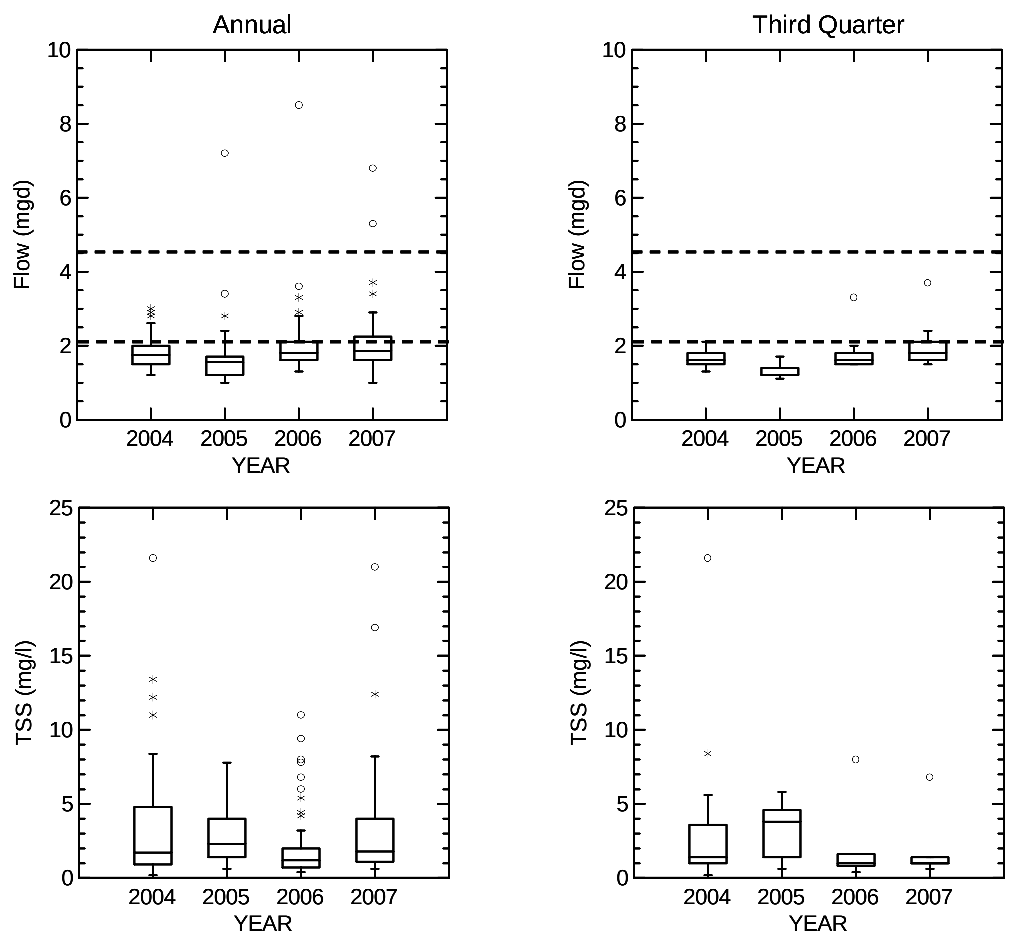


Figure 62. Annual and third quarter effluent flows and TSS concentrations from Bolingbrook STP. The design maximum and average daily flow for the plant is shown by dashed lines in the flow plots. The permit limit for monthly average TSS concentration is 25 mg/l.

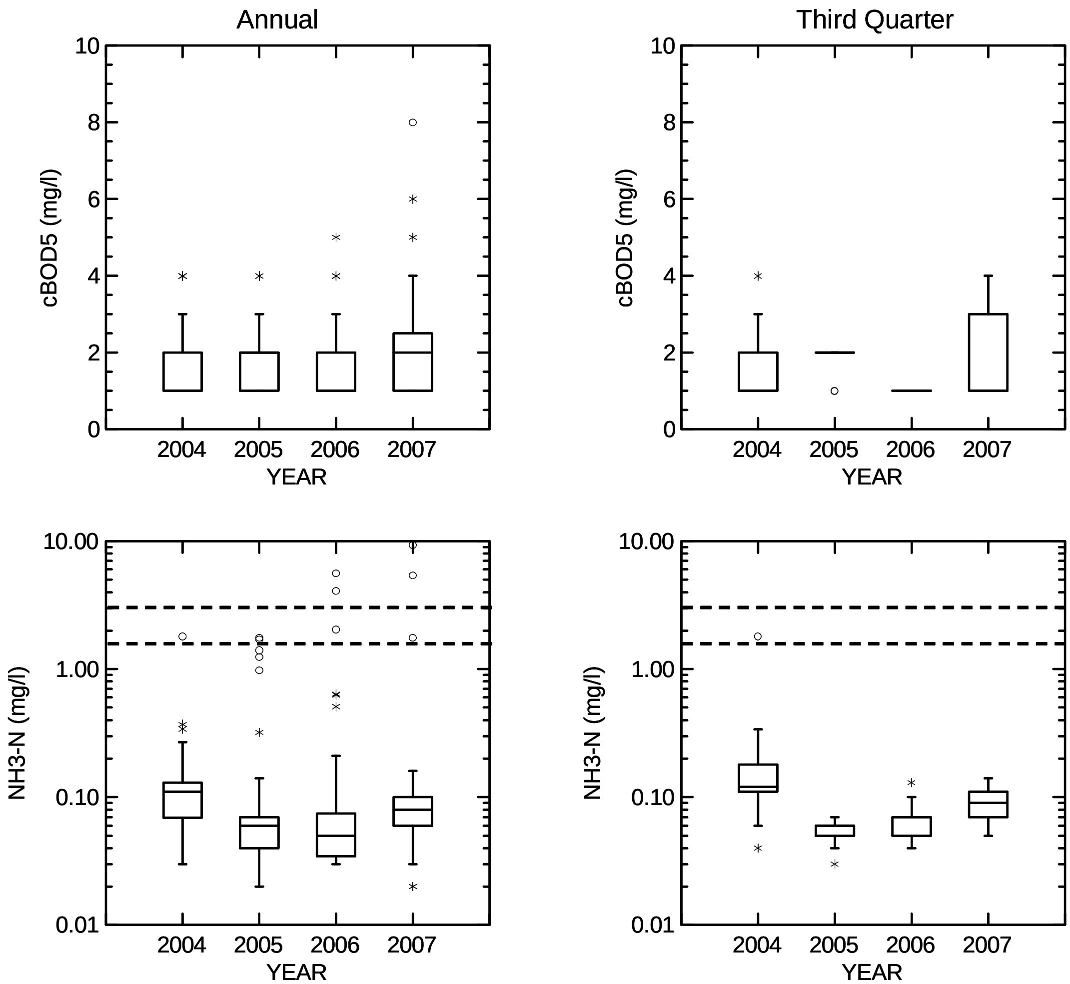


Figure 63. Annual and third quarter concentrations cBOD5 and NH3-N from Bolingbrook STP. The permit limit for monthly average cBOD5 concentration is 20 mg/l. Dashed lines in the ammonia plots show the April-October monthly average (3.0 mg/l) and daily maximum (1.5 mg/l) permit limits.

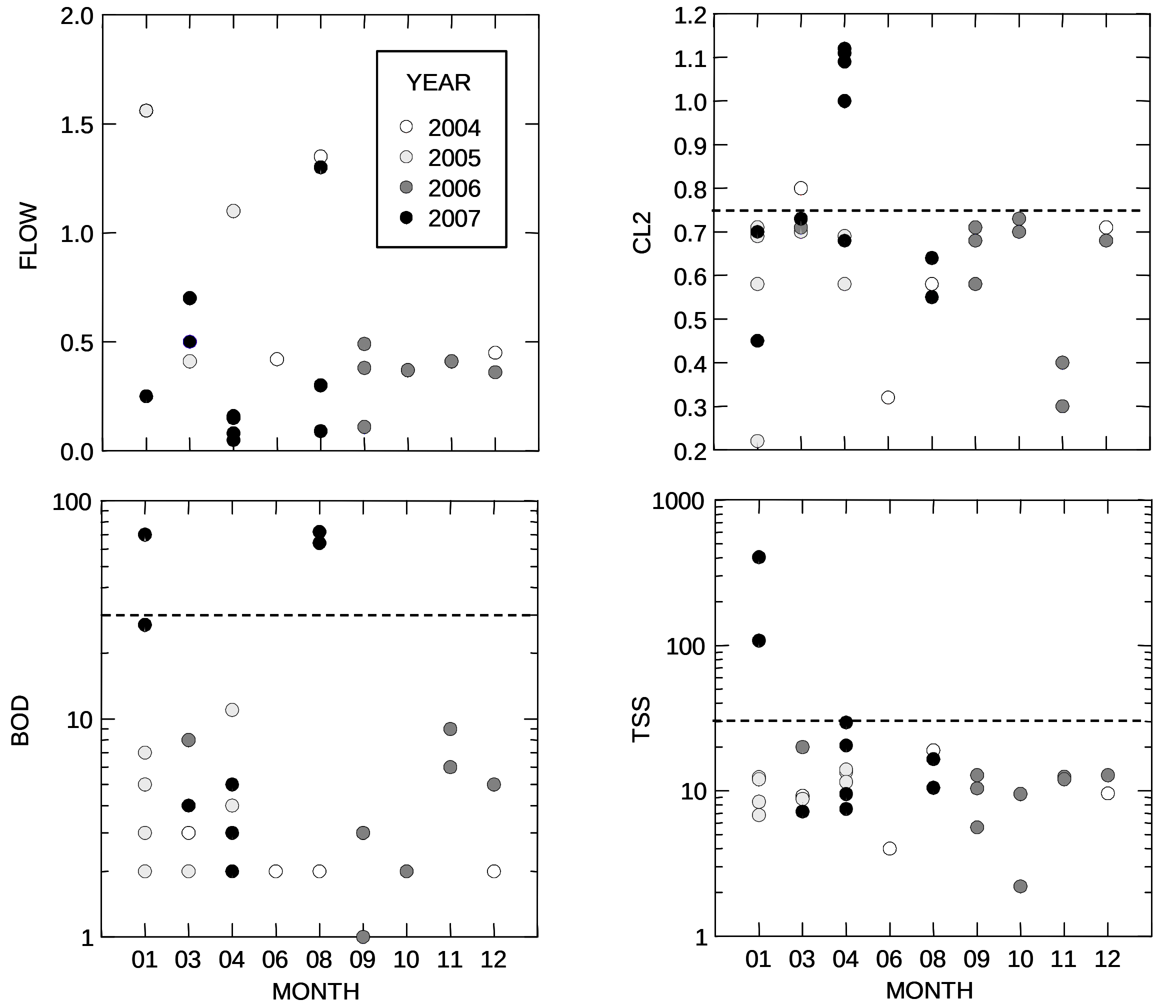


Figure 64. Excess flows (MGD) subject to secondary treatment standards (40 CFR 133.102; 35 IAC 302.208) for the years 2004 - 2007. The monthly average limits residual chlorine, BOD, and TSS are shown as dashed lines.

DCDPW WOODRIDGE-GREEN VALLEY STP [IL0031844] The Woodridge STP has a design average flow of 12 MGD and design maximum of 28.6 MGD. Annual and third quarter median flows from the plant have not exceeded the design average of 12 MGD between 1999 and 2007 (Figure 65). Ninety-fifth percentile annual flows exceeded the design average in most years, but flow rarely exceeded the design maximum. Concentrations of annual and third quarter cBOD5 were less than the daily maximum of 20 mg/l allowed in the permit; however, concentrations trended higher in 2006 and 2007 (Figure 66). Similarly, annual and third quarter concentrations of TSS were below permitted limits except for several outliers. However, 95th percentile 3rd quarter NH3 concentrations exceeded the daily maximum limit in most years (Figure 66), suggesting the plant was occasionally not operating at peak efficiency. Over the past several years efforts have been initiated to address nutrient removal at the Woodridge Green Valley Facility due to occasional exceedence of the NPDES permit discharge limitations. Historical and current efforts are as follows:

Pilot Scale

- Construction and operation of a fully functional aerobic/anoxic pilot plant for treating continuous flow from plant effluent and side-streams. The operation included the study of attached growth media as well as multiple processes configurations.

- Pilot scale study of aerobic treatment of plant influent and separate study of side-streams to determine oxidation potential of ammonia nitrogen.

- Pilot scale study of treatment using addition of nitrifying bacteria to enhance nutrient removal.

Processes Investigated

- Conversion of an on-site decommission facility for full scale treatment of ammonia nitrogen using pilot scale data.

- A system to promote formation of struvite to remove ammonia nitrogen from in-plant processes flow streams.

- Anammox® and a combination of Sharon®/Anammox® processes.

- Sequencing Batch Reactor Technology (SBR).

Full Scale

- Construction of a 70,000 gallon holding facility for concentrated ammonia nitrogen side-streams to introduce a consistent loading to the treatment plant and reduce potential for ammonia spikes, overloading and bleeding through the biological processes.

- Construction of a pump station in conjunction with the holding facility to remove excess concentrated side-streams from the Woodridge Facility to the Knollwood Facility for treatment.

- Construction of stormwater clarifier for treatment of peak wet weather flows to maintain a consistent biology for the treatment of ammonia nitrogen.

- Modification of existing nitrification trickling filter facilities to improve scour velocity and enhance development of nitrifying bacteria.

Current

The plant has entered into a contract with CH2M Hill specifying the services of Dr. Glen Daigger to evaluate, identify and recommend technologies available for full-scale treatment and removal of nutrients associated with the Woodridge Greene Valley influent and side-streams. Funding of a full-scale treatment process and expenditure of approximately 2 million dollars has been identified in the Woodridge Green Valley capital improvement program as part of a bond issued in August of this year.

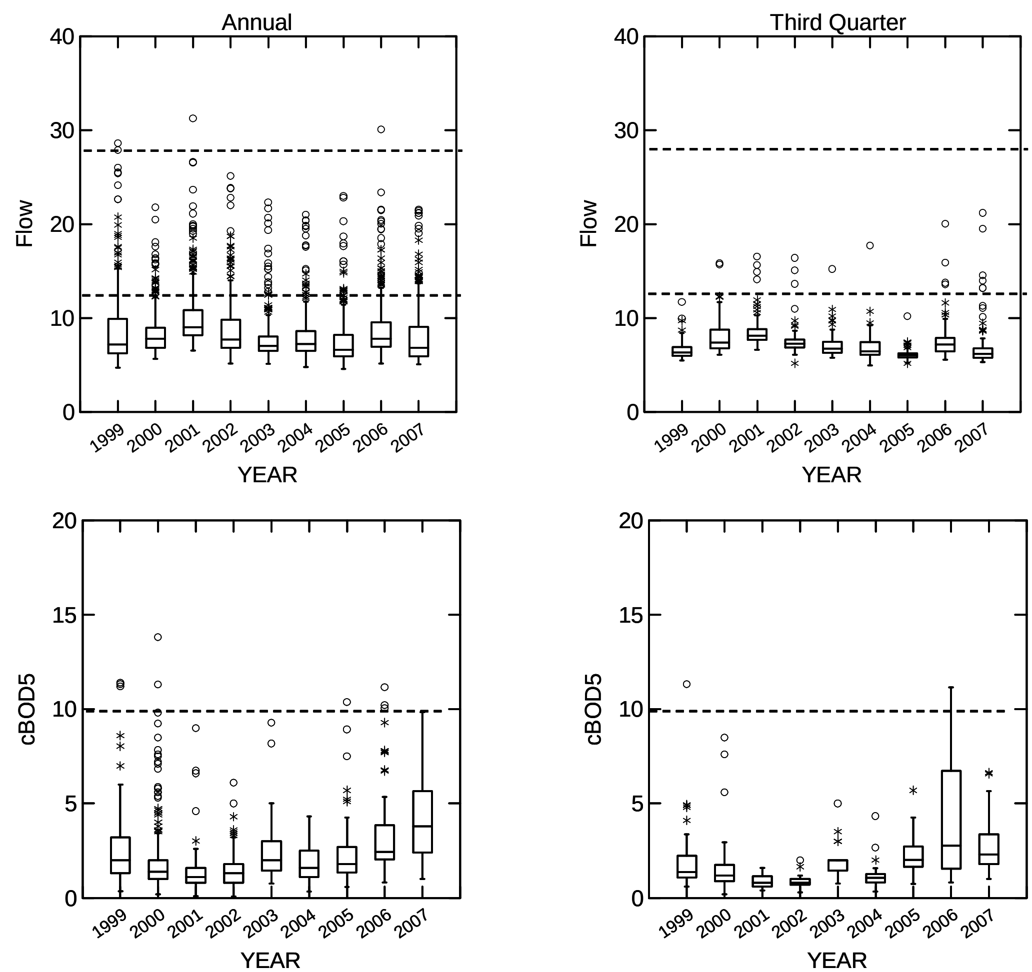


Figure 65. Annual and third quarter effluent flows and cBOD5 concentrations from the DCDPW Woodridge-Green Valley STP. The design maximum and average design flow for the plant is shown by stippled lines in the flow plots. The dashed line in the cBOD5 plot depicts the monthly average effluent limit.

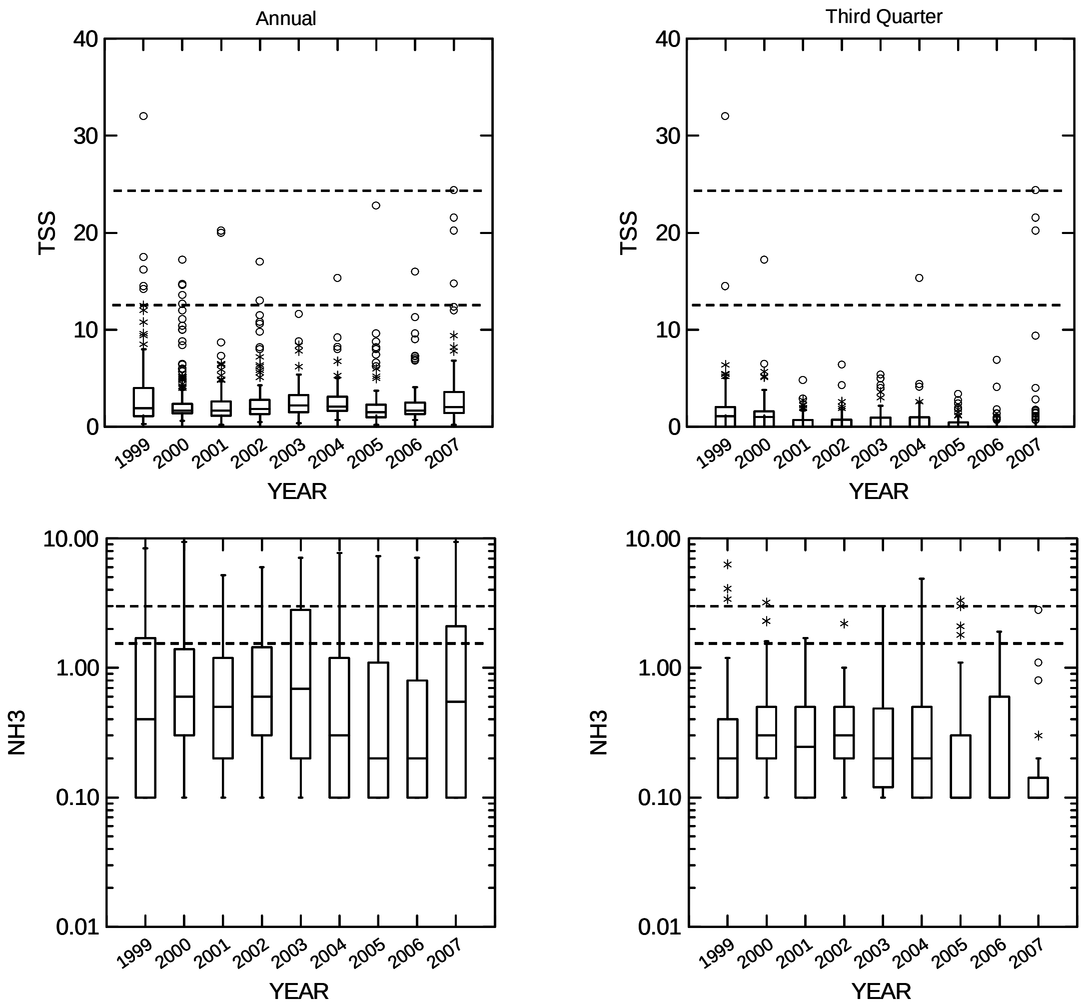


Figure 66. Upper and middle panels, annual and third quarter effluent concentrations for TSS and NH3 reported by the Woodridge-Green Valley STP plotted by year. The monthly and weekly average effluent limits for TSS are denoted by dashed lines. The April through October monthly average and daily maximum limits are shown for ammonia. Lower panels, monthly concentrations of NH3 and fecal coliform counts for 1998-2007 in relation to applicable permit limits (dashed lines).

DOWNERS GROVE SANITARY DISTRICT [IL0028380] The design average flow for the treatment facility is 11 million gallons per day (MGD) and the design maximum flow for the facility is 22 MGD. Treatment consists of screening, grit removal, primary clarification, activated sludge, secondary clarification, filtration, excess flow treatment, disinfection and sludge treatment. The 10-year recurrent 7-day low flow (Q7/10) of the receiving stream, East Branch of DuPage River, is 14 cfs.

Annual median and 75th percentile flows from the plant typically fall below the design average, and extreme flows rarely exceeded the design maximum. Ninety-fifth percentile flows during the third quarter were typically near the design average, and the design maximum was exceeded only once in the eight years reported. Annual and third quarter effluent concentrations of cBOD (Figure 67), and TSS and NH3-N (Figure 68) were typically less than respective monthly average limits, and always less than weekly (cBOD5 and TSS) and daily (NH3) maximums, indicating consistent and efficient treatment over the reporting period. Additionally, effluent concentrations of ammonia nitrogen have trended downward.

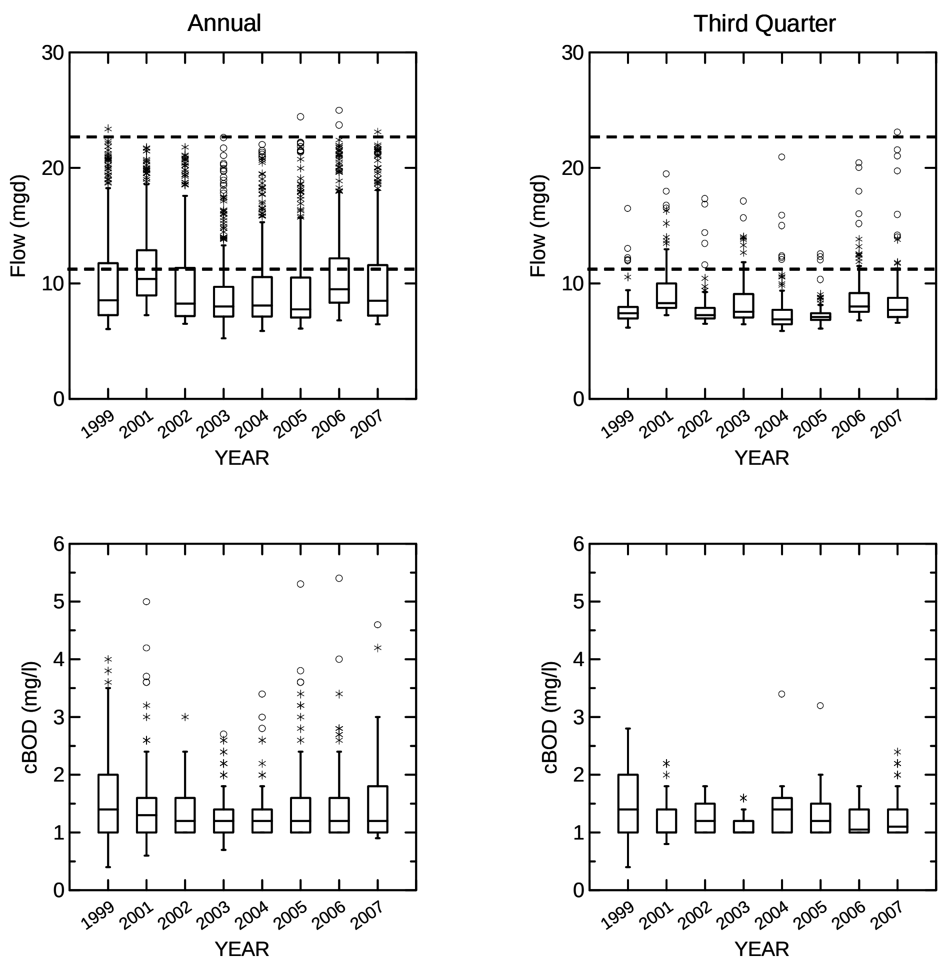


Figure 67. Annual and third quarter effluent flows and cBOD concentrations from the Downers Grove SD WTC. The design maximum and average daily flow for the plant is shown by dashed lines in the flow plot. The monthly average cBOD5 limit for the plant is 10 mg/l.

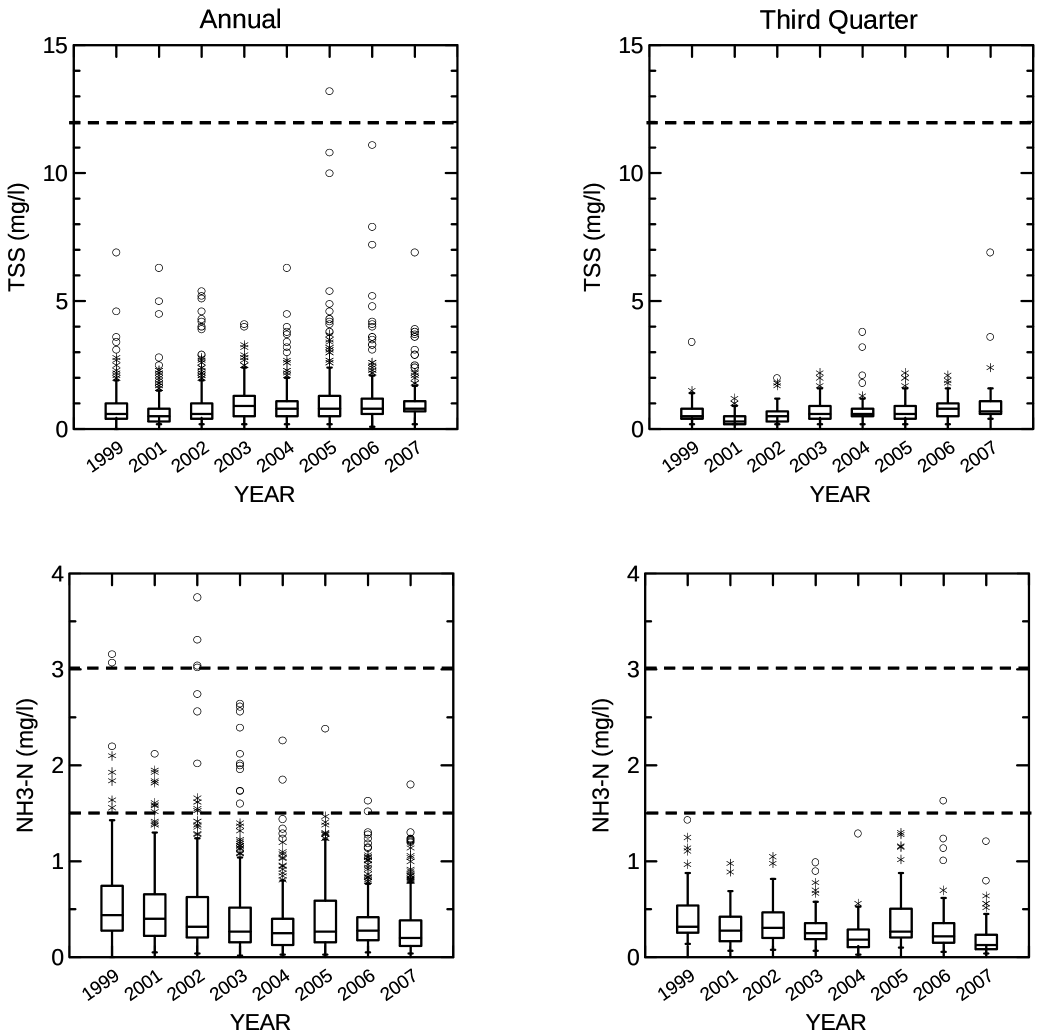


Figure 68. Annual and third quarter effluent concentrations for TSS (upper panel) and NH3-N (lower panel) reported by the Downers Grove SD WTC. The monthly average limit for TSS is shown by dashed lines (the weekly average for TSS is 24 mg/l). The April through October monthly average and daily limits are shown for ammonia.

GLENBARD WASTEWATER AUTHORITY-GLENBARD [IL0021547] The design average flow (DAF) for the treatment facility is 16.02 million gallons per day (MGD) and the design maximum flow (DMF) for the facility is 47 MGD. Treatment consists of screening, primary settling tanks, aeration tanks, intermediate clarifiers, final settling tanks, filtration, ultraviolet disinfection system, and sludge handling facilities. This treatment facility? has an approved pretreatment program. Median and maximum monthly flows from the plant have averaged 10.65 MGD and 20.64 MGD, respectively, for the time period 1998 – 2007. Flows from the plant have trended downward over the time period (Figure 69). Effluent concentrations of cBOD5 and TSS were consistently less than respective permit limits for both daily maximums and monthly averages (Figure 70). Effluent concentrations of ammonia nitrogen frequently exceeded permit limits between July, 2002 and April, 2003; however, concentrations between 2004 and 2007 were consistently less than applicable monthly average and daily maximum limits. Median and maximum effluent concentrations of ammonia nitrogen for the months of May through October averaged 0.126 and 0.650 mg/l between 2004 and 2007 (Figure 71).

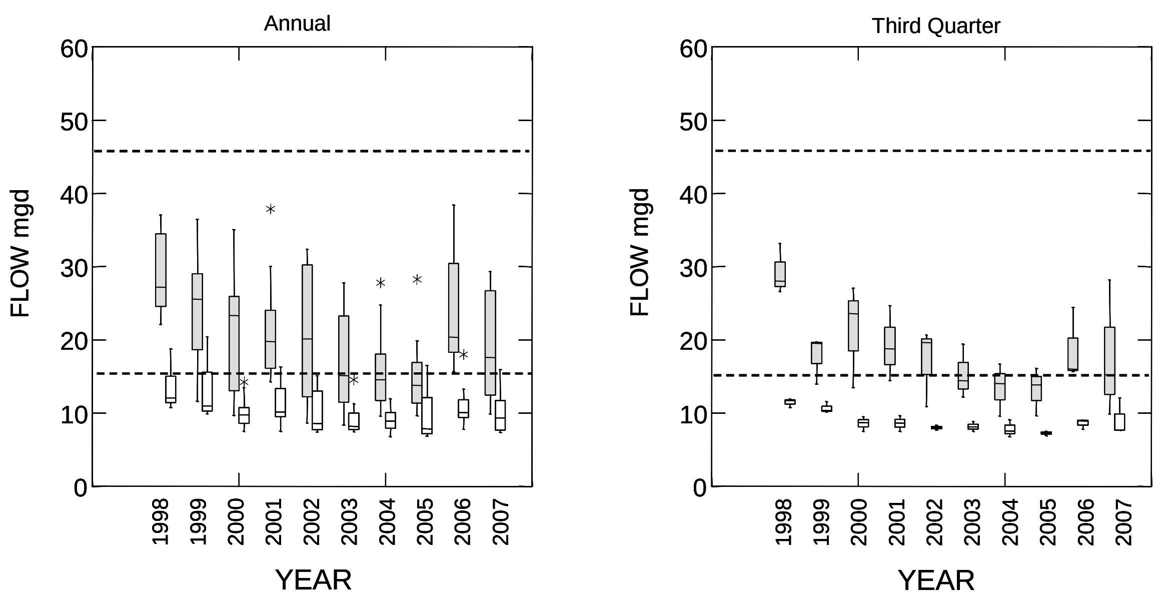


Figure 69. Distributions of monthly maximum (gray shading) and median (open shading) plant flows by year for the Glenbard Wastewater Authority-Glenbard WWTP stratified by annual and third quarter time periods. The design maximum flow of 47 MGD and average design flow of 16.02 MGD are shown as dashed lines in both plots.

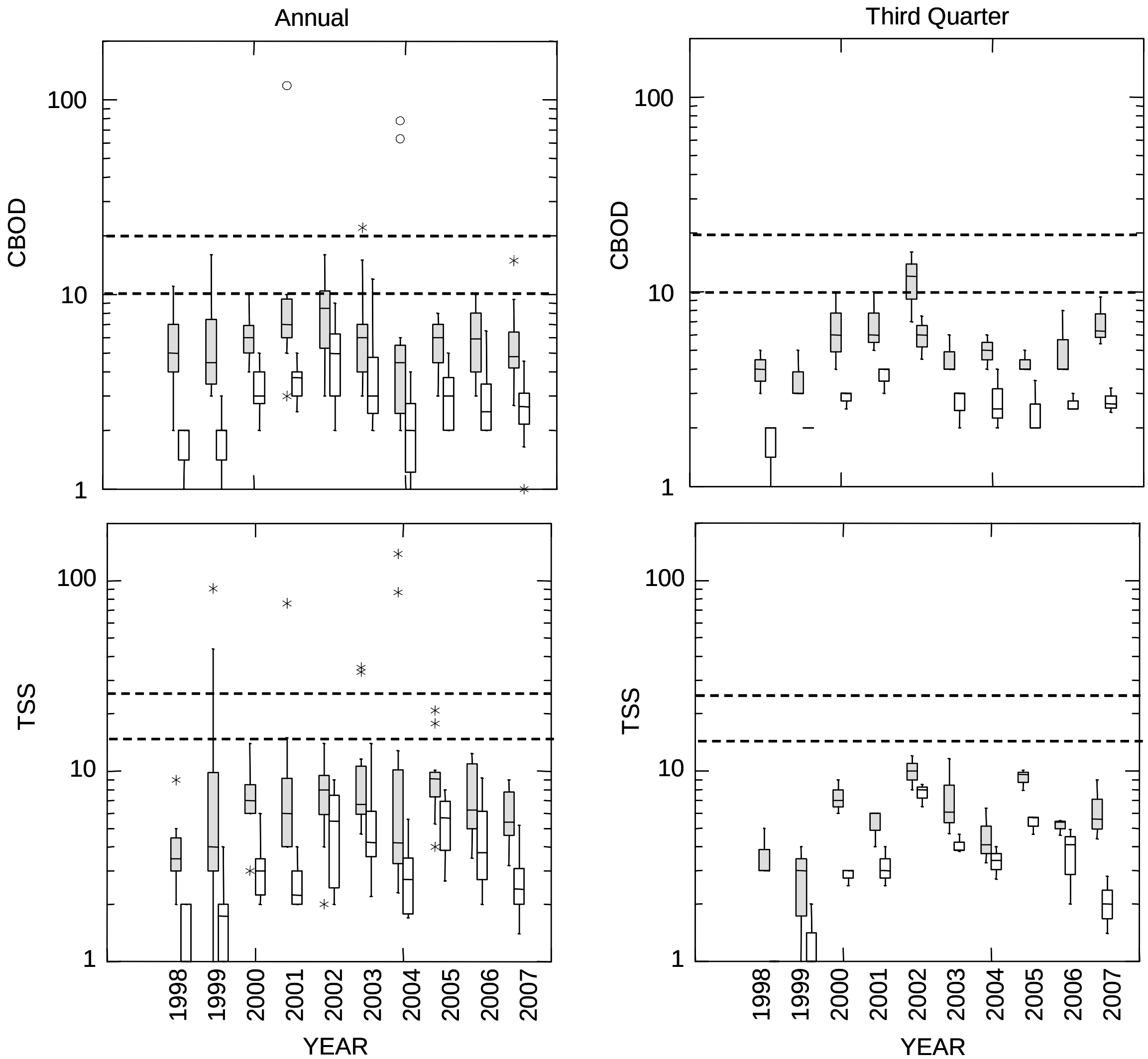


Figure 70. Distributions of annual and third quarter monthly maximum (shaded boxes) and median (open boxes) effluent concentrations of cBOD5 (top panel) and TSS (lower panel) for the Glenbard Wastewater Authority-Glenbard WWTP. Weekly and monthly average permit limits are shown as dashed lines.

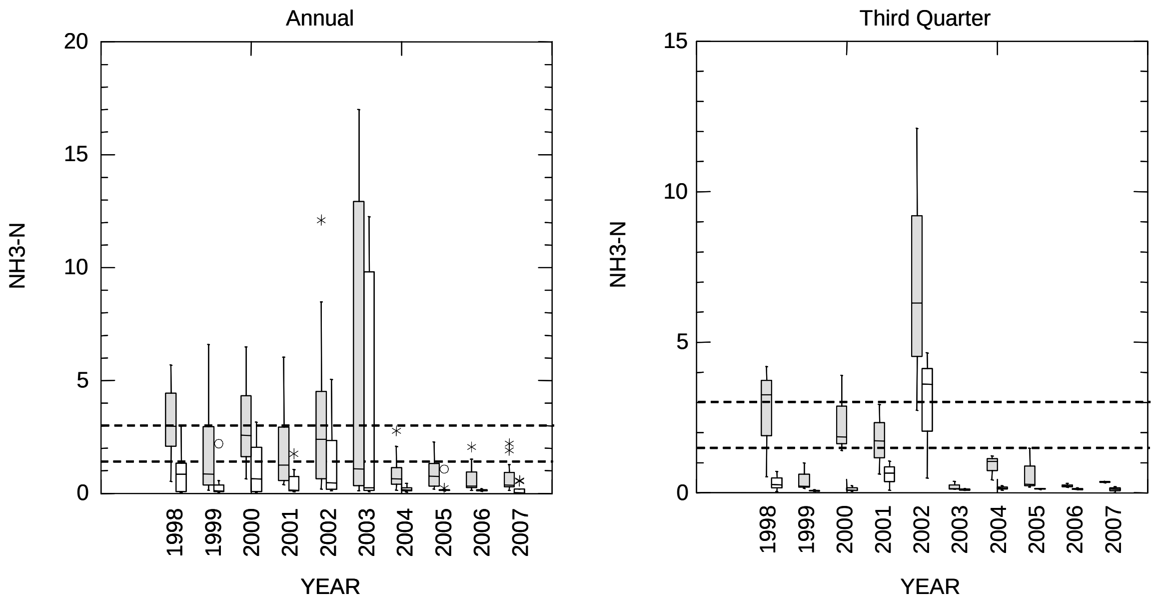


Figure 71. Distributions of annual and third quarter monthly maximum (shaded boxes) and median (open boxes) effluent concentrations of ammonia nitrogen for the Glenbard Wastewater Authority-Glenbard WWTP. Daily maximum and monthly average permit limits are shown as dashed lines.

GLENBARD WASTEWATER AUTHORITY, LOMBARD COMBINED SEWAGE TREATMENT FACILITIES [IL0022471] The 10-year recurrent 7-day low flow (Q7/10) of the receiving stream, East Branch of DuPage River,is 4 cfs. The design average flow (DAF) for the treatment facility is N/A and the design maximum flow (DMF) for the facility is 58.0 MGD. Treatment consists of screening, grit removal, sedimentation and disinfection. Discharges from the plant were reported in seven of fourteen months between December, 2006 and February, 2008. All reported maximum flows were less than the design maximum capacity; however, concentrations of TSS and BOD5 associated with the discharges averaged 36 and 49 mg/l, respectively, and were likely acutely stressful to the biota.

GLENDALE HEIGHTS STP [IL0028967] The design average flow (DAF) for the facility is 5.25 million gallons per day (MGD) and the design maximum flow (DMF) for the facility is 10.52 MGD. Treatment consists of two mechanical bar screens, influent pumping station, grit removal system, three primary sedimentation tanks, four activated sludge aeration tanks, two secondary clarifiers, three tertiary sand filters, two post aeration tanks, chlorine disinfection system, sodium bisulfite dechlorination, two aerobic digesters, two belt filter presses, and two excess flow clarifiers.

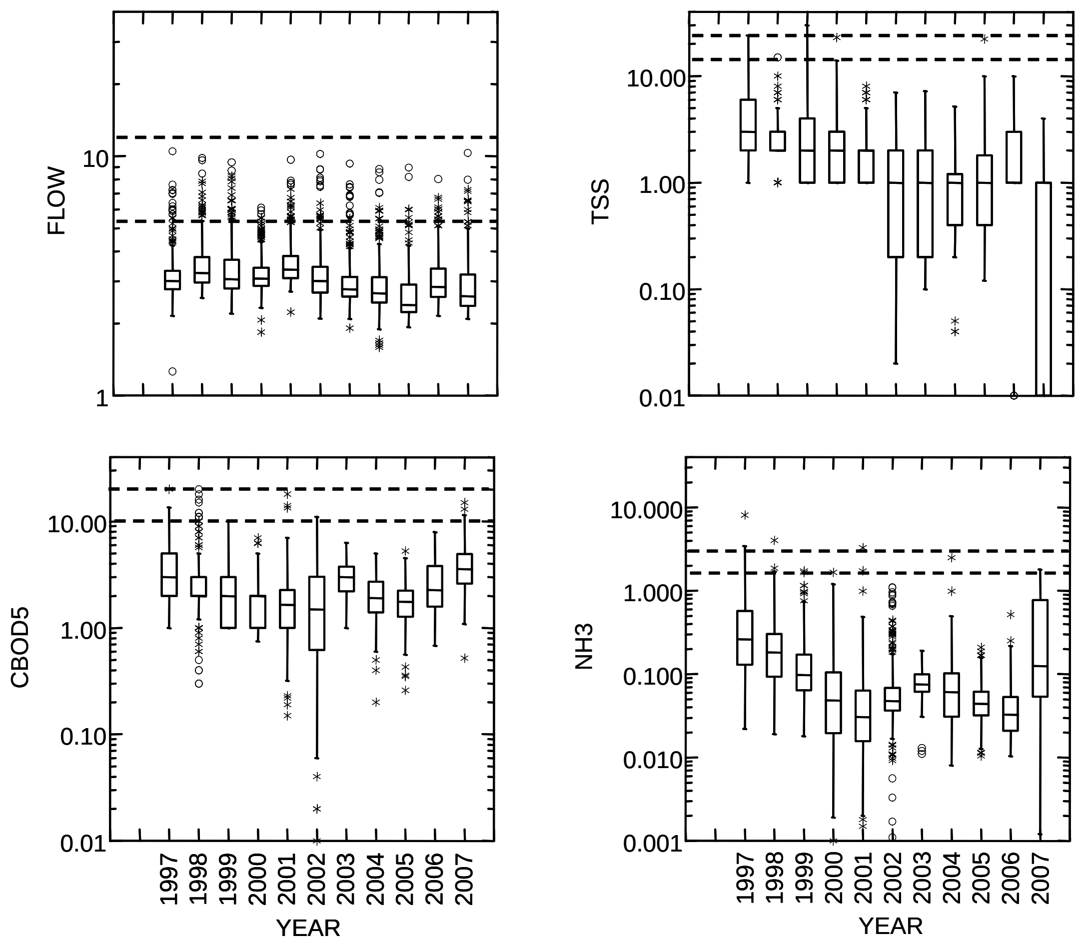


Figure 72. Annual effluent data for the Glendale Heights [IL0028967] Sewage Treatment Plant. Upper left, flow in millions of gallons per day; upper right, total suspended solids in milligrams per liter (mg/l); lower left, 5-day carbonaceous biological oxygen demand (mg/l); and lower right, ammonia nitrogen (mg/l). Dashed lines in the flow plot show the design maximum and the daily average design flow. Dashed lines in the TSS, cBOD5, and NH3 plots show the respective effluent limits for the daily average and monthly maximums.

Daily flows from the plant were typically less than the design average capacity (Figure 72) for the period of record (1997-2007). Concentrations of TSS, cBOD5 and ammonia nitrogen occasionally exceeded daily average limits and rarely exceeded monthly average limits, especially after 2001. Concentrations of cBOD5 and NH3-N appeared to have trended upward in 2007. Third quarter effluent data (Figure 73) mirrored the annual data; however, third quarter concentrations of cBOD5 and NH3-N tended to be slightly higher than annual concentrations.

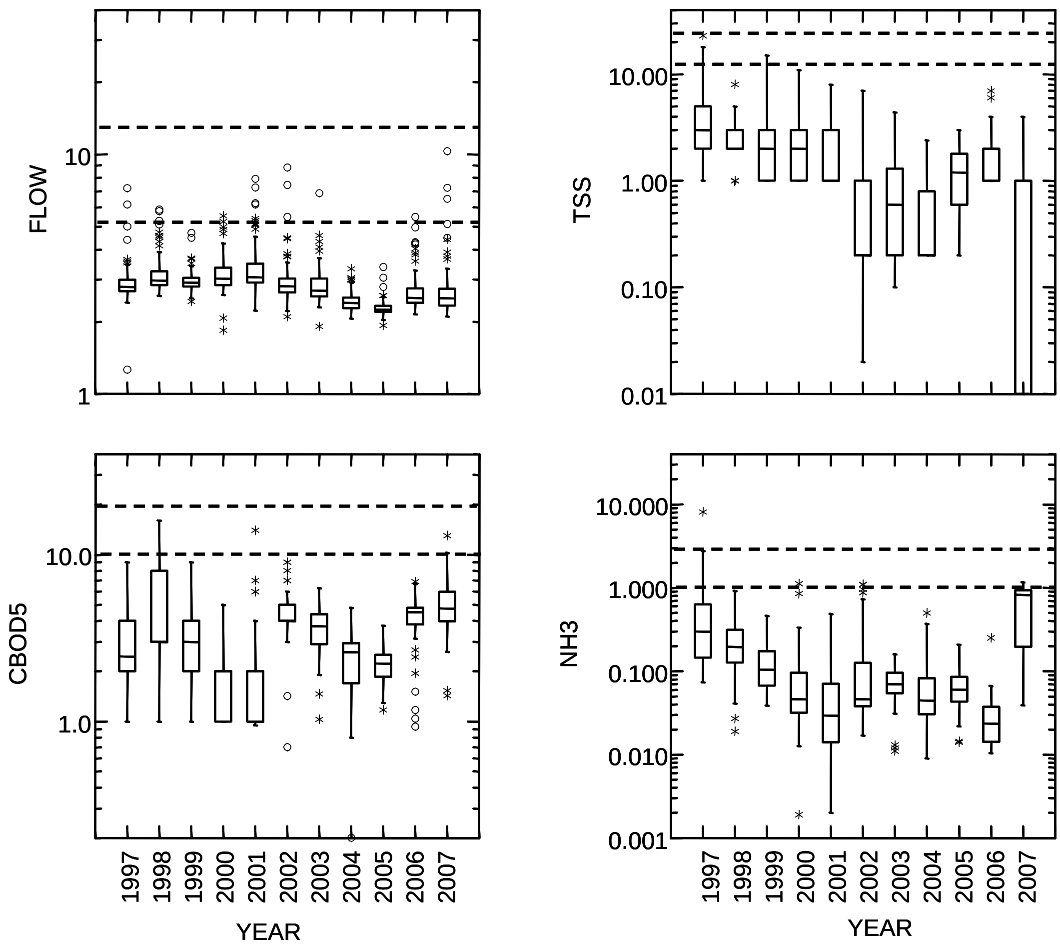


Figure 73. Third quarter effluent data for the Glendale Heights [IL0028967] Sewage Treatment Plant. Upper left, flow in millions of gallons per day; upper right, total suspended solids in milligrams per liter (mg/l); lower left, 5-day carbonaceous biological oxygen demand (mg/l); and lower right, ammonia nitrogen (mg/l). Dashed lines in the flow plot show the design maximum and the daily average design flow. Dashed lines in the TSS, cBOD5, and NH3 plots show the respective effluent limits for the daily average and monthly maximums.

BLOOMINGDALE-REEVES WRF [IL0021130] The 10-year recurrent 7-day low flow (Q7/10) of the receiving stream, East Branch of the DuPage River, is 0 cfs. The design average flow (DAF) for the treatment facility is 3.450 million gallons per day (MGD) and the design maximum flow (DMF) for the facility is 8.625 MGD. Treatment consists of screening, aeration, final clarifiers, intermittent sand filters, chlorination, dechlorination, aerobic digesters, sludge handling, and excess flow treatment.

Annual and third quarter effluent flows from the plant never exceeded the plant design maximum, and were typically less than the design daily average. However, little difference existed between third quarter and annual flows (Figure 74). Effluent concentrations of NH3-N, cBOD5 and TSS were usually less than applicable permit limits except in 2006 when third quarter TSS concentrations frequently exceed the daily maximum limit. Elevated ammonia concentrations, though not exceeding the daily maximum limit, were coincident with the high TSS concentrations (Figure 74). Plant bypasses occurring when effluent flows were less than the design average capacity were common prior to 2007 (Figure 75), whereas excess discharges in 2007 and 2008 occurred when the flows were at or near the average design capacity. Excess flows occurring prior to 2007 appear to have been minimally treated, given their BOD5 concentrations were typical for raw sewage (Figure 75).

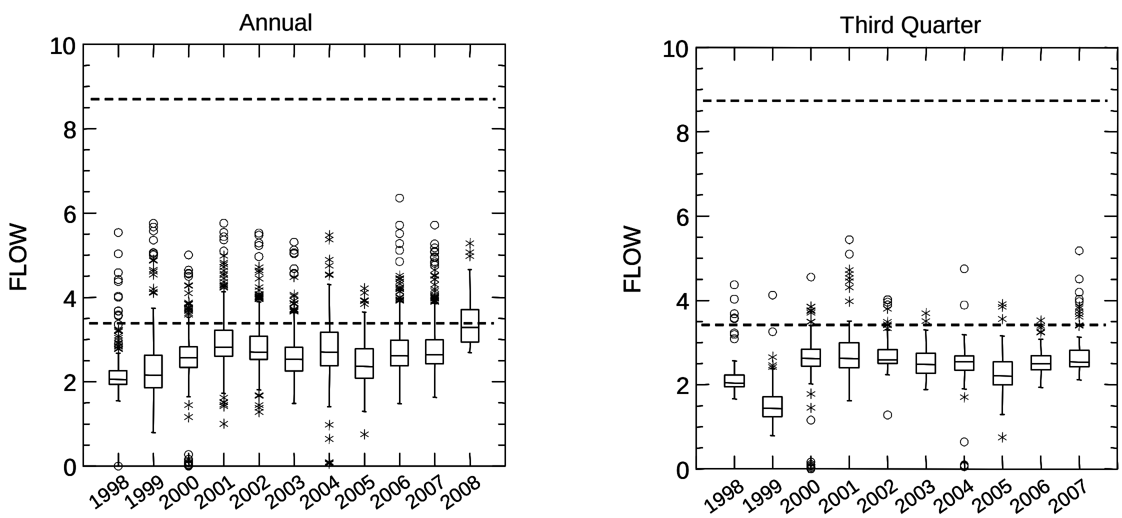


Figure 74. Annual and third quarter effluent flows and cBOD concentrations from the Bloomingdale-Reeves WRF. The design maximum and average daily flow for the plant is shown by dashed lines in the flow plot.

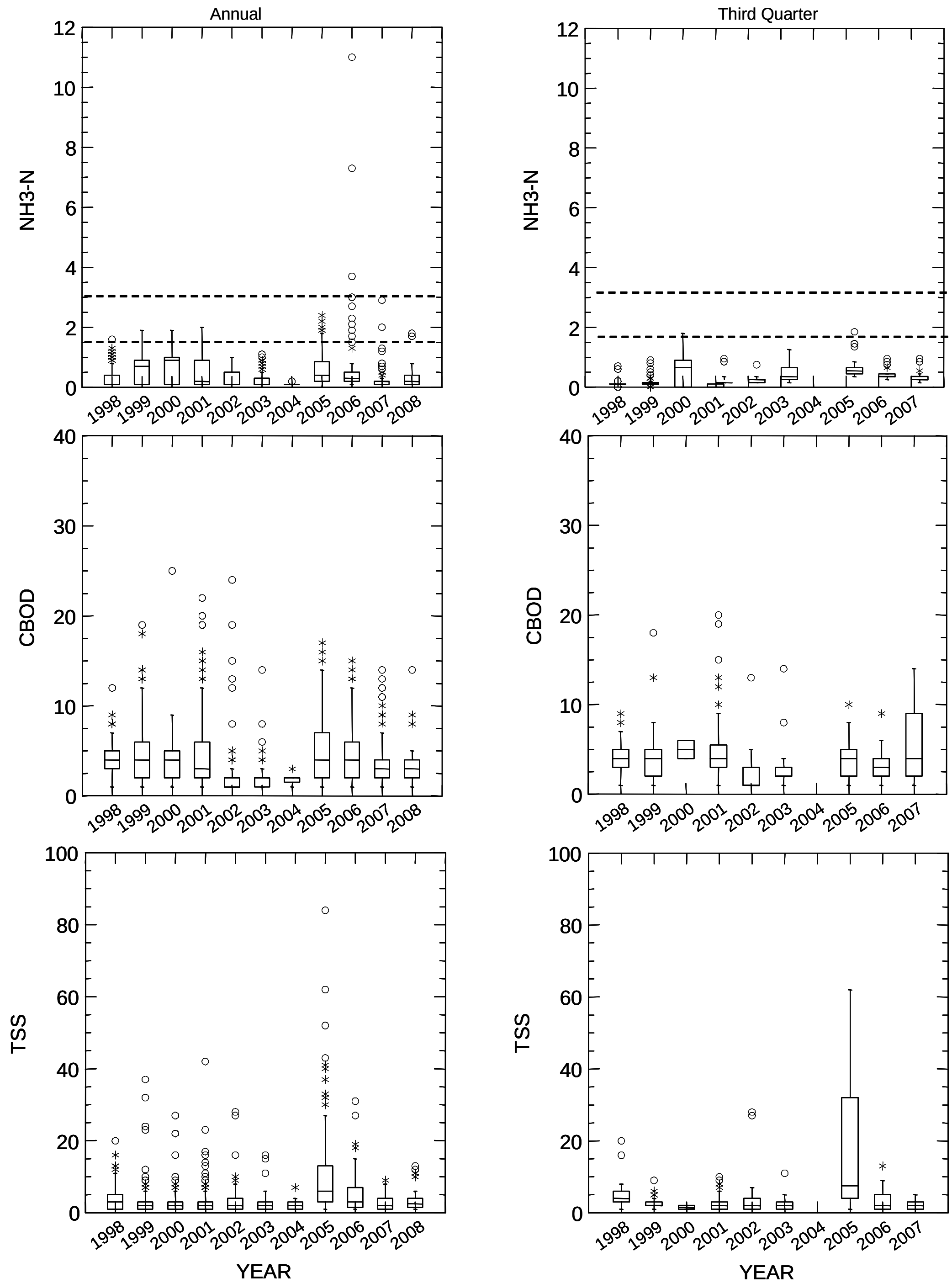


Figure 75. Distributions of annual and third quarter effluent concentrations of NH3-N(top panel), cBOD5 (middle panel), and TSS (lower panel) for the Bloomingdale-Reeves WRF. Weekly and monthly average permit limits are shown as dashed lines.

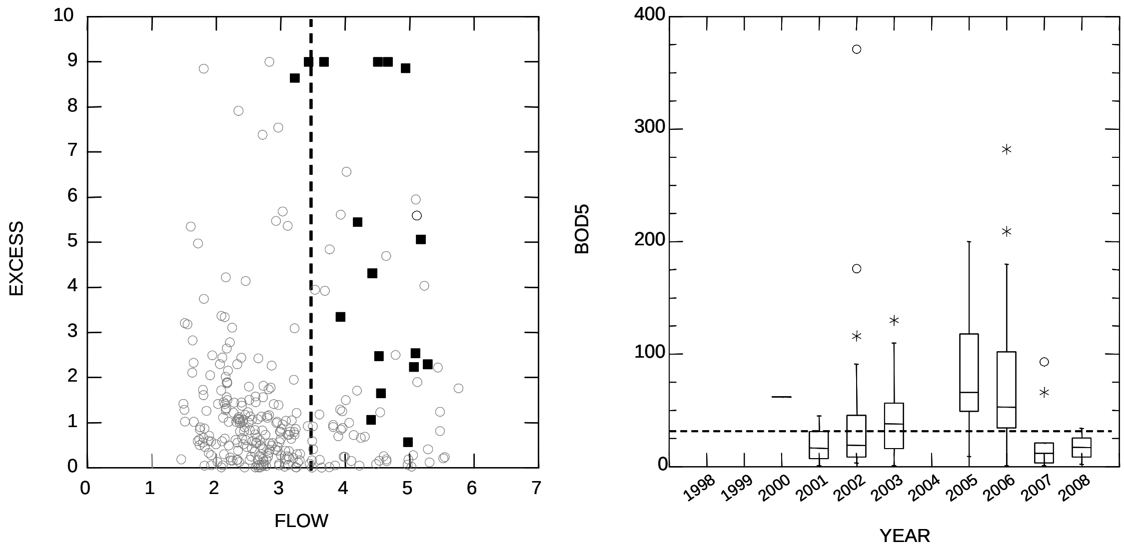


Figure 76. Left panel, excess flows as a function of plant flow for the Bloomingdale-Reeves WRF for the years 1998 through April, 2008. Solid square points are for 2007 and 2008 data. Right panel, distributions of BOD5 concentrations in excess flows by year.

Water Chemistry – East Branch

Stream flow in the East Branch during the summer months is composed upwards of seventy-five percent treated wastewater effluent. As such, its water quality is influenced by the concentrations and composition of chemical constituents in the effluent. Water quality samples collected in 2007 during the late summer through early fall low-flow period suggest that the quality of treated effluent, with respect to regulated parameters (i.e., BOD, TSS, NH3 and D.O.), was good, and did not result directly in exceedences of water quality standards. Concentrations of NH3 were less than 1.0 mg/l in all samples collected along the mainstem (Figure 77). Elevated ammonia concentrations are symptomatic of poorly or untreated sewage, and ammonia concentrations greater than 1.0 mg/l represents a threshold beyond which chronic toxicity is likely.

However, secondary effects from high concentrations of nutrients negatively affected water quality. Concentrations of NO3-N and TP were high relative to unpolluted streams (Figures 77 and 78), and appeared to stimulate high levels of autotrophic productivity. Concentrations of TKN, an indicator of the living or recently dead fraction of the seston, were high, especially in the reach between RMs 20 and 10 (Figure 78), and coincident with high levels of BOD and TSS (Figure 79). The high productivity drove wide swings in dissolved oxygen that resulted in concentrations falling below water quality standards at Saint Charles Road (RM 20) in 2006 (see Table 12; Figure 80 and 81). Wide daily swings in dissolved oxygen concentrations were also recorded by continuous monitors at Hidden Lake and Hobson Road in 2006 (Figure 80). Although these swings did not always result in water quality standards exceedences in 2006 (Figures 82 and 83), the associated daily minimums frequently were less than 5.0 mg/l and occasionally less than 4.0 mg/l. In 2007, wide D.O. swings were noted at every station in June and July (Figure 86), but especially at Churchill Woods and Hidden Lake Forest Preserves (RMs 19.0 and 14.0, respectively). Minimum at any time standards were exceeded at all sampling stations in 2007 (Table 12; Figure 87). Stream flows were lower, and therefore presumably more prone to showing the effects of enrichment in 2007 compared to 2006. Note that the automated data loggers were set in a dam pools at Churchill Woods and wide, slow moving reach at Hidden Lake.

Table 13. Water quality standards exceedences noted in water quality samples collected from the East Branch DuPage River and its tributaries, 2006-2007.

Water Body	Location	Date	Constituent	Concentration	Standard
2006 Sonde Deployments					
East Branch	EBSC	06/27-28/06	D.O.	<6.0 mg/l	7-day MAVG
		07/14-19/06	D.O.	<6.0 mg/l	7-day MAVG
		08/04-09/06	D.O.	<4.0 mg/l	7-day Min
East Branch	EBCW	07/27-28/06	D.O.	<5.0 mg/l	Not to exceed
		08/08-09/06	D.O.	<3.5 mg/l	Not to exceed
		08/15-16/06	D.O.	<3.5 mg/l	Not to exceed
		08/25-27/06	D.O.	<3.5 mg/l	Not to exceed

Table 13. Continued.

Water Body	Location	Date	Constituent	Concentration	Standard
2007 Sonde Deployments					
East Branch	EBAT	09/05-14/07	D.O.	<4.0 mg/l	7-day Min
East Branch	EBAT	06/20-07/07/07	D.O.	<6.0 mg/l	7-day MAVG
East Branch	EBCW	08/08-11/07	D.O.	<4.0 mg/l	7-day Min
East Branch	EBCW	08/27-28/07	D.O.	<4.0 mg/l	7-day Min
East Branch	EBBR	08/07/07	D.O.	<4.0 mg/l	7-day Min
East Branch	EBBR	07/08-14/07	D.O.	<6.0 mg/l	7-day MAVG
East Branch	EBHR	08/07-08/07	D.O.	<4.0 mg/l	7-day Min
East Branch	EBHL	07/10-14/07	D.O.	<6.0 mg/l	7-day MAVG
East Branch	EBHL	07/10-12/07	D.O.	<6.0 mg/l	7-day MAVG
East Branch	EBAT	June - 29 times	D.O.	<5.0 mg/l	Not to exceed
		July - 17 times	D.O.	<5.0 mg/l	Not to exceed
		Aug - 1 times	D.O.	<3.5 mg/l	Not to exceed
		Sept - 7 times	D.O.	<3.5 mg/l	Not to exceed
East Branch	EBCW	July - 2 times	D.O.	<5.0 mg/l	Not to exceed
		Aug - 7 times	D.O.	<3.5 mg/l	Not to exceed
East Branch	EBBR	June - 23 times	D.O.	<5.0 mg/l	Not to exceed
		July - 26 times	D.O.	<5.0 mg/l	Not to exceed
		Aug - 1 times	D.O.	<3.5 mg/l	Not to exceed
East Branch	EBHL	June - 29 times	D.O.	<5.0 mg/l	Not to exceed
		July - 2 times	D.O.	<5.0 mg/l	Not to exceed
		Aug - 1 times	D.O.	<3.5 mg/l	Not to exceed
East Branch	EBHR	June - 14 times	D.O.	<5.0 mg/l	Not to exceed
		July - 15 times	D.O.	<5.0 mg/l	Not to exceed

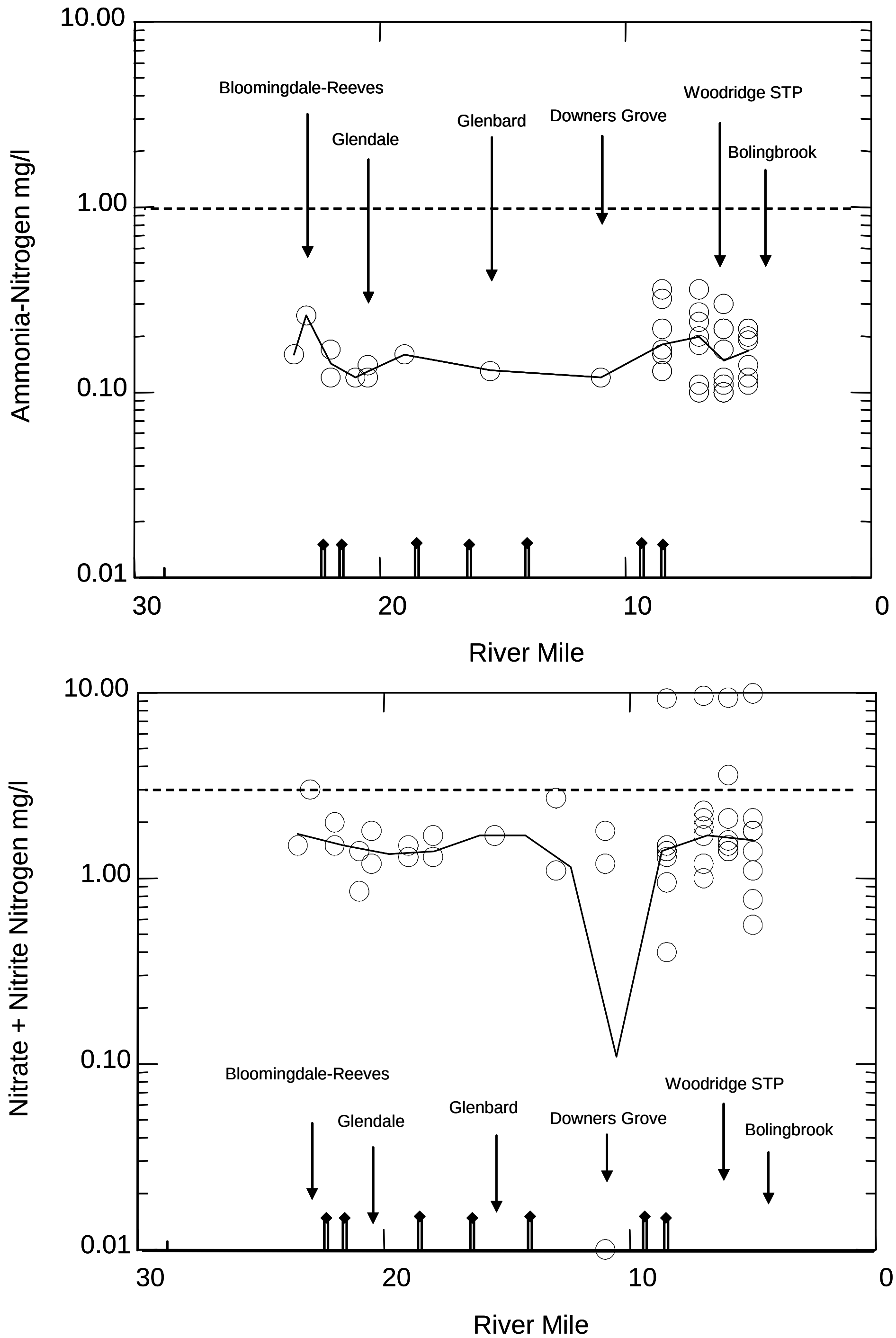


Figure 77. Concentrations of ammonia nitrogen (top panel) and nitrate-nitrite nitrogen (lower panel) in water quality samples collected from the East Branch DuPage River in 2007. Approximate discharge locations of municipal wastewater treatment plants are shown. The diamond-tipped bars along the x-axis show the locations of dams along the mainstem. The dashed line in the ammonia plot shows a threshold concentration beyond which toxicity is likely, and the dashed line in the nitrate-nitrite plot shows the upper limit of concentrations typical for unpolluted waters.

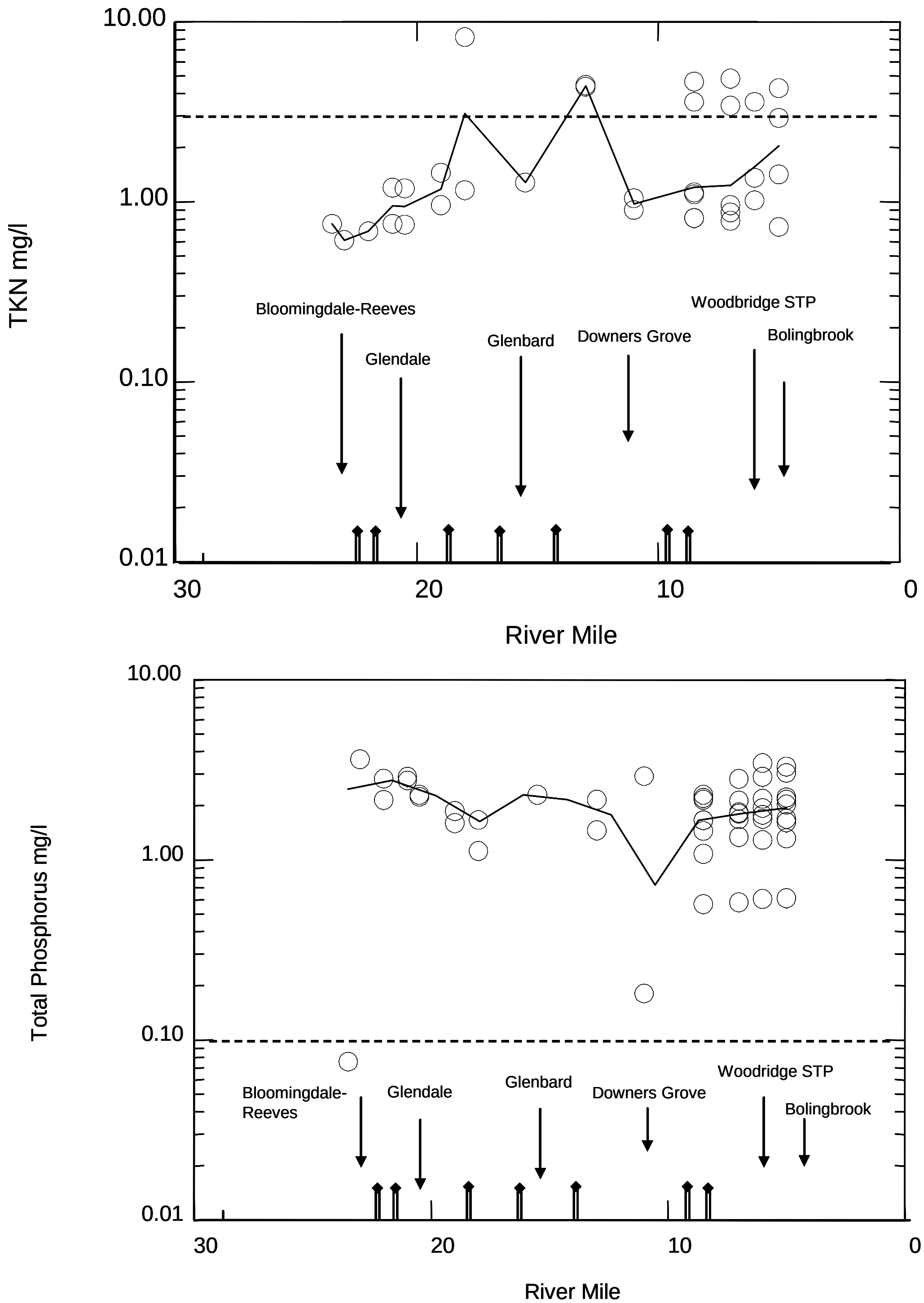


Figure 78. Concentrations of total Kjeldahl nitrogen (top panel) and total phosphorus (lower panel) in water quality samples collected from the East Branch DuPage River in 2007. Approximate discharge locations of municipal wastewater treatment plants are shown. The diamond-tipped bars along the x-axis show the locations of dams along the mainstem. The dashed line in each plot shows the upper limit of concentrations typical for unpolluted waters.

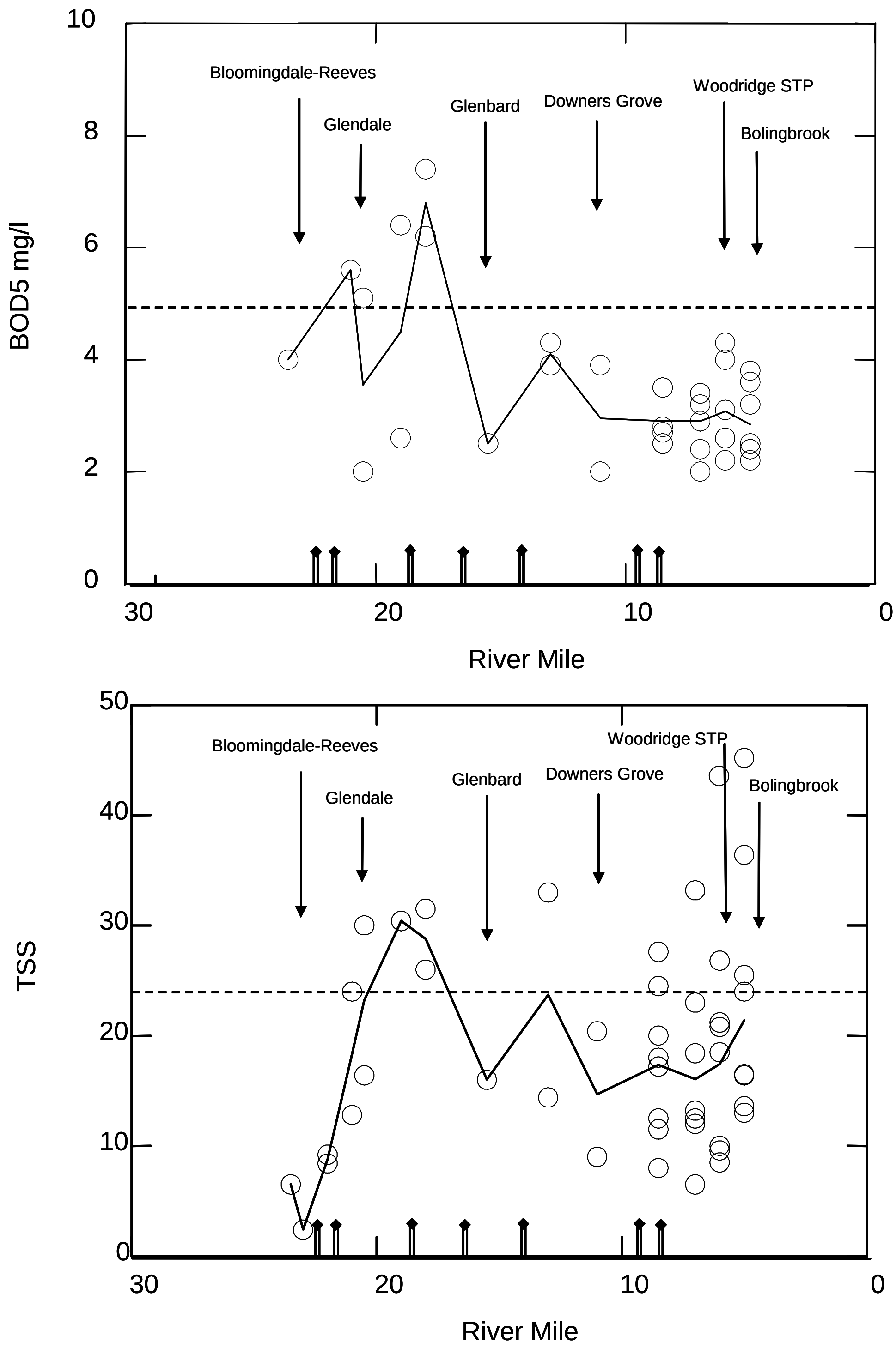


Figure 79. Concentrations of 5-day biological oxygen demand (top panel) and total suspended solids (lower panel) in water quality samples collected from the East Branch DuPage River in 2007. Approximate discharge locations of municipal wastewater treatment plants are shown. The diamond-tipped bars along the x-axis show the locations of dams along the mainstem. The dashed line in each plot shows the upper limit of concentrations typical for unpolluted waters.

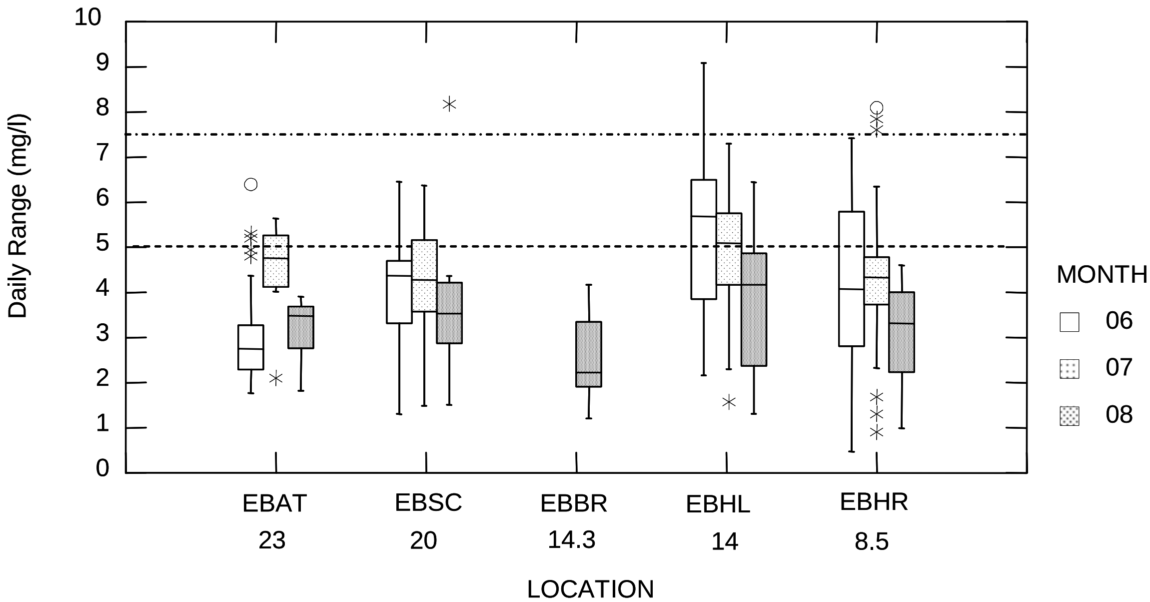


Figure 80. Distributions of the 24 hour range of dissolved oxygen concentrations recorded by continuous monitors in the East Branch, 2006, plotted by location and month. The river mile of the location is shown below each station. Stations are: EBAT, Army Trail; EBSC, Saint Charles; EBBR, Butterfield Road; EBHL, Hidden Lake; and EBHR, Hobson Road. Dashed lines represent range magnitudes of increasing stress to aquatic life.

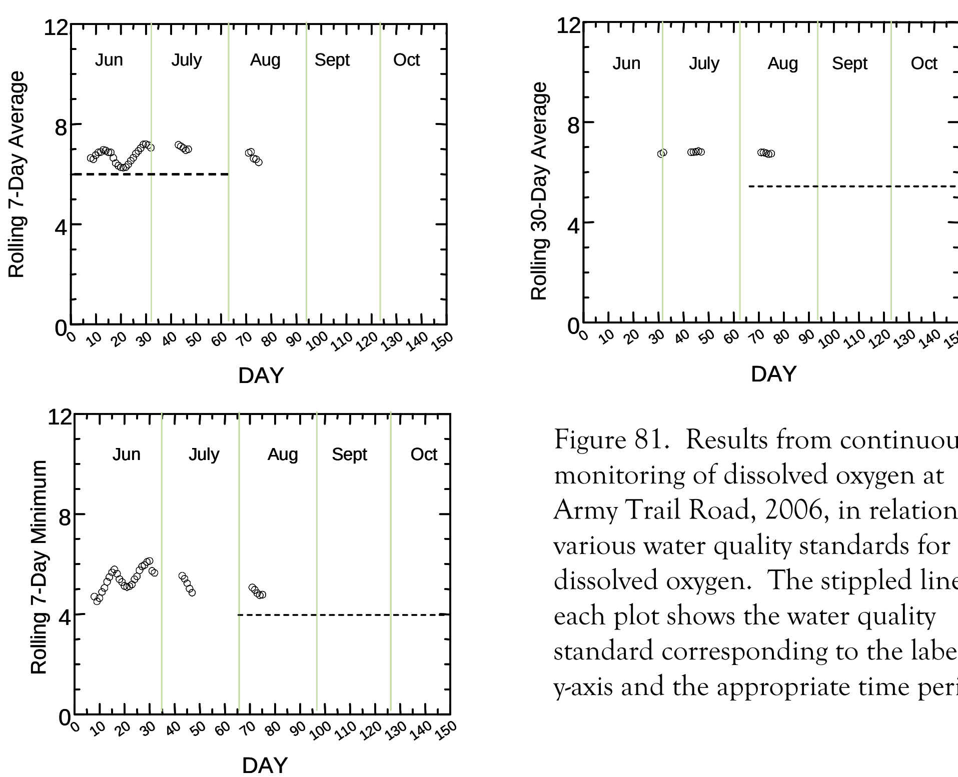


Figure 81. Results from continuous monitoring of dissolved oxygen at Army Trail Road, 2006, in relation to various water quality standards for dissolved oxygen. The stippled line in each plot shows the water quality standard corresponding to the labeled y-axis and the appropriate time period.

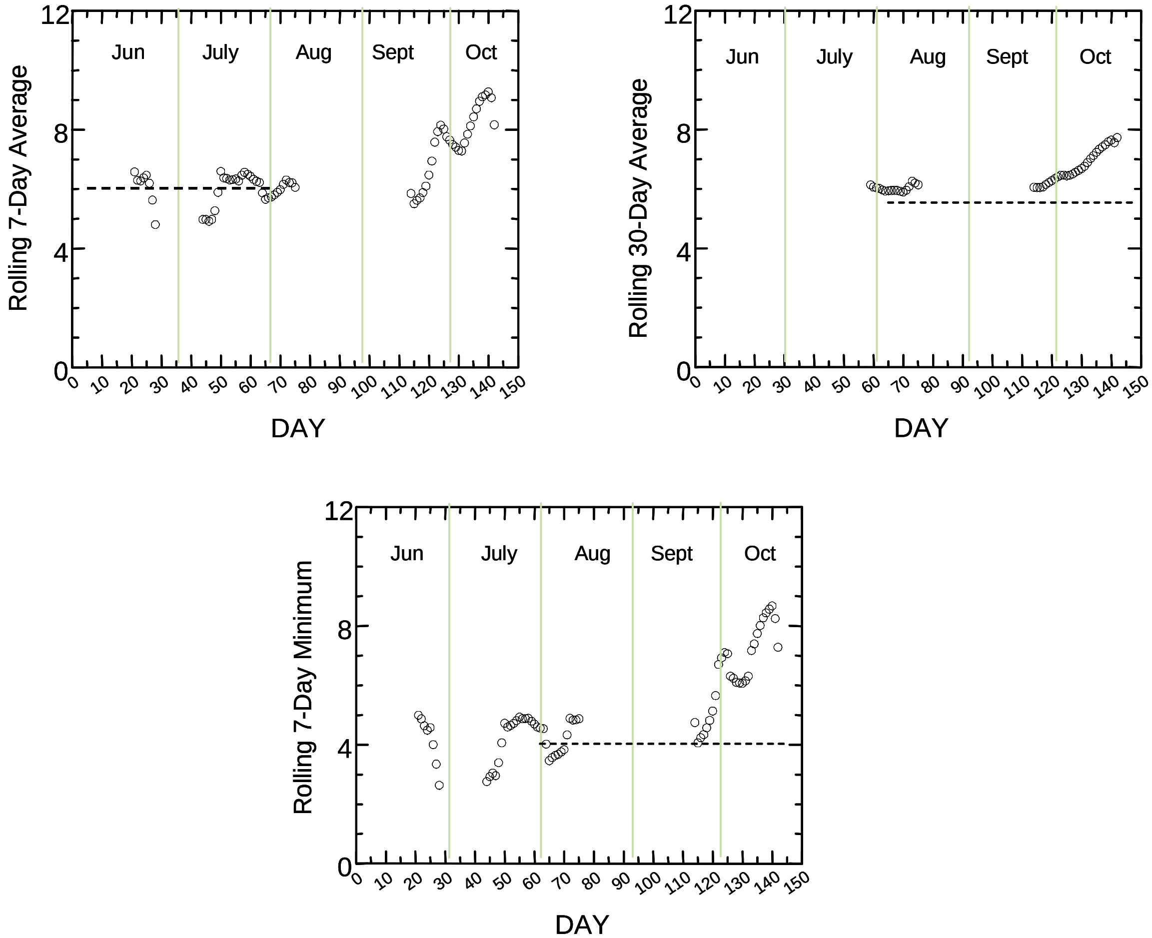


Figure 82. Results from continuous monitoring of dissolved oxygen at St. Charles Road, 2006, in relation to various water quality standards for dissolved oxygen. The dashed line in each plot shows the water quality standard corresponding to the labeled y-axis and the appropriate time period.

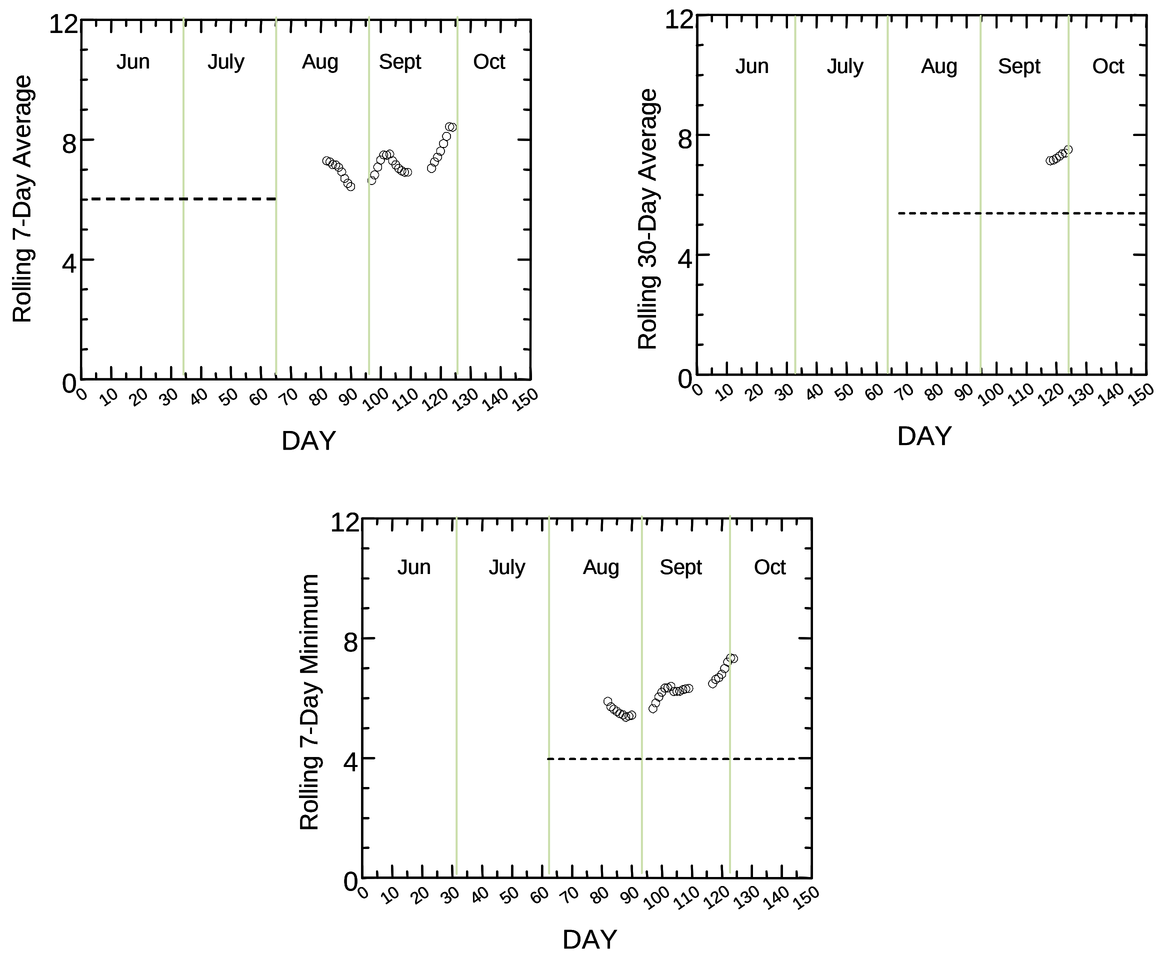


Figure 83. Results from continuous monitoring of dissolved oxygen at Butterfield Road, 2006, in relation to various water quality standards for dissolved oxygen. The dashed line in each plot shows the water quality standard corresponding to the labeled y-axis and the appropriate time period.

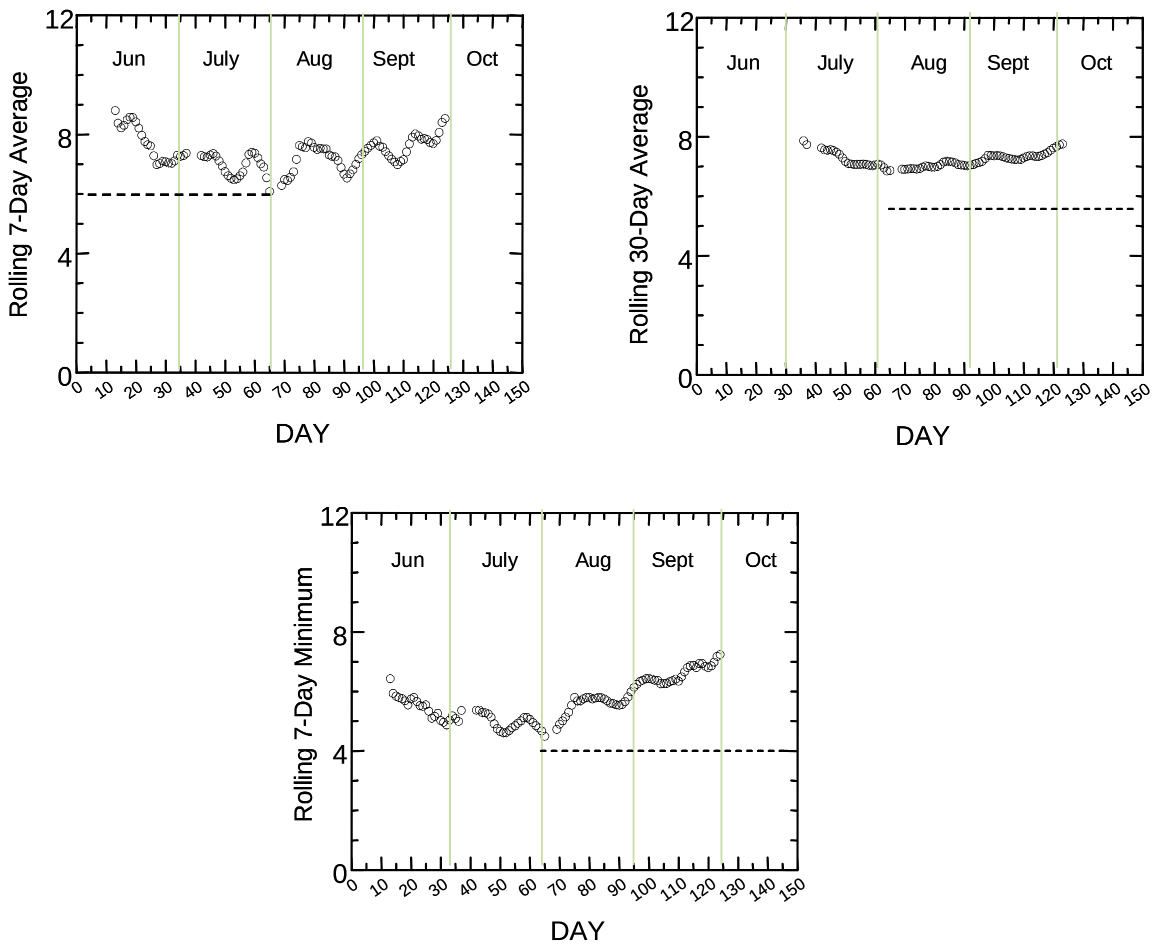


Figure 84. Results from continuous monitoring of dissolved oxygen at Hidden Lake Forest Preserve, 2006, in relation to various water quality standards for dissolved oxygen. The dashed line in each plot shows the water quality standard corresponding to the labeled y-axis and the appropriate time period.

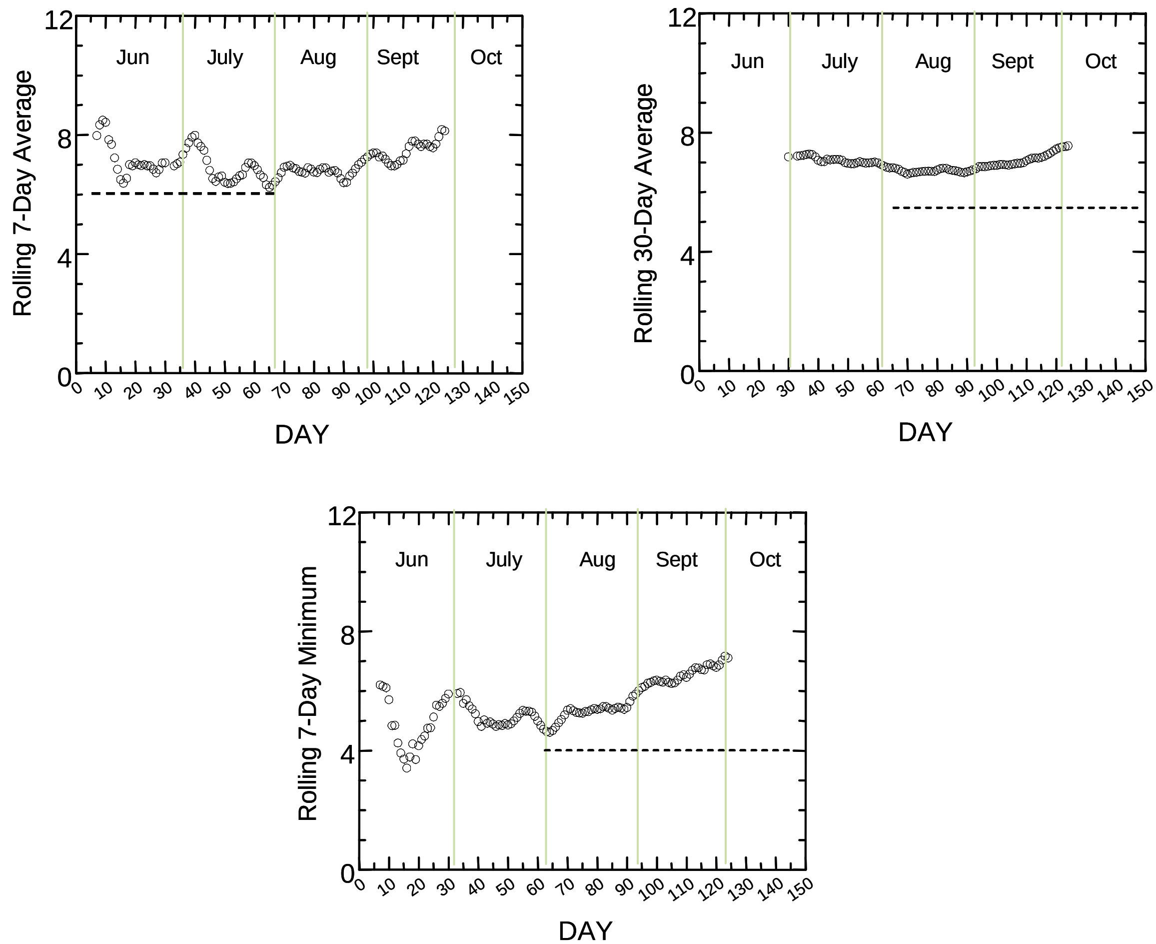


Figure 85. Results from continuous monitoring of dissolved oxygen at Hobson Road, 2006, in relation to various water quality standards for dissolved oxygen. The dashed line in each plot shows the water quality standard corresponding to the labeled y-axis and the appropriate time period.

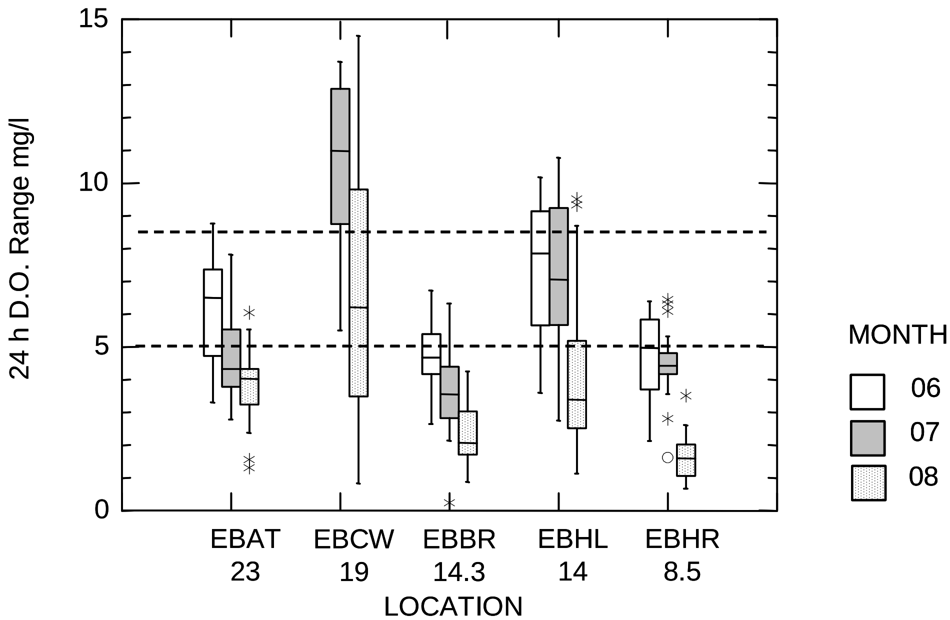
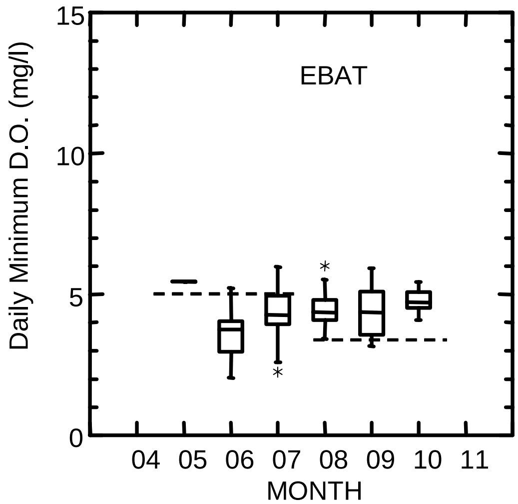
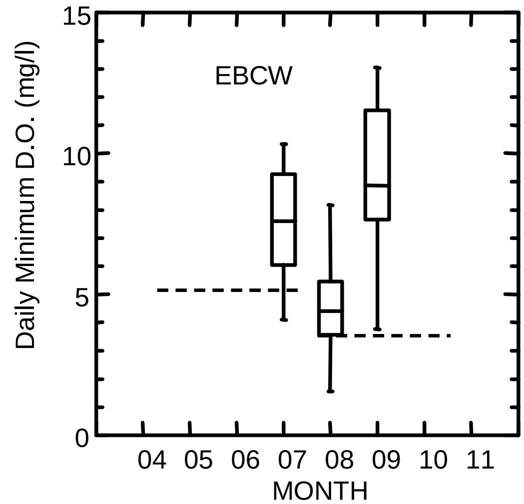
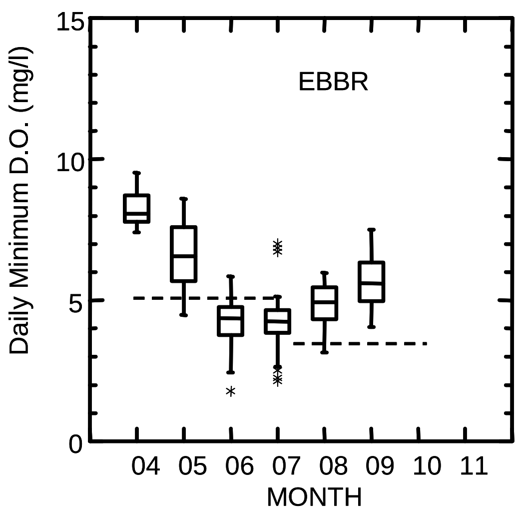
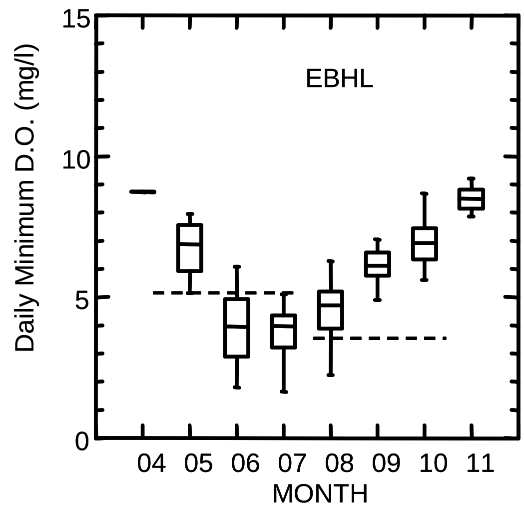


Figure 86. Distributions of the 24 hour range of dissolved oxygen concentrations recorded by continuous monitors in the East Branch, 2007, plotted by location and month. The river mile of the location is shown below each station. Stations are: EBAT, Army Trail; EBCW, Churchill Woods; EBBR, Butterfield Road; EBHL, Hidden Lake; and EBHR, Hobson Road. Dashed lines represent range magnitudes of increasing stress to aquatic life.









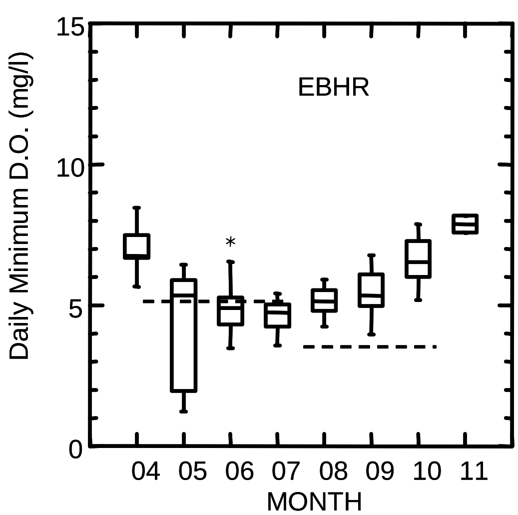


Figure 87. Distributions of minimum daily dissolved oxygen concentrations recorded by automated data loggers, 2007, in the East Branch. Station locations are: EBAT, Army Trail Road; EBCW, Churchill Woods; EBBR , Butterfield Road; EBHL, Hidden Lake, EBHR, Hobson Road. Dashed lines represent the seasonal water quality standard for instantaneous minimum dissolved oxygen concentration.

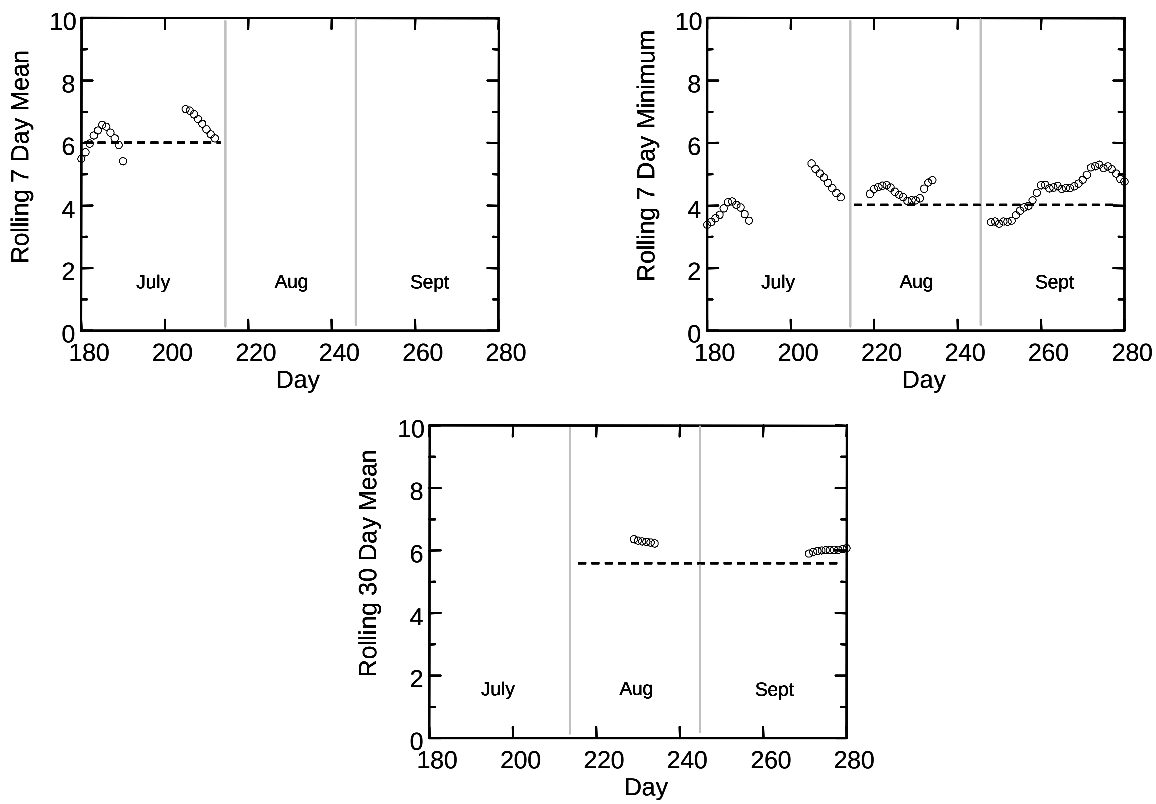


Figure 88. Results from continuous monitoring of dissolved oxygen at Army Trail Road in relation to various water quality standards for dissolved oxygen. The dashed line in each plot shows the water quality standard corresponding to the labeled y-axis and the appropriate time period.

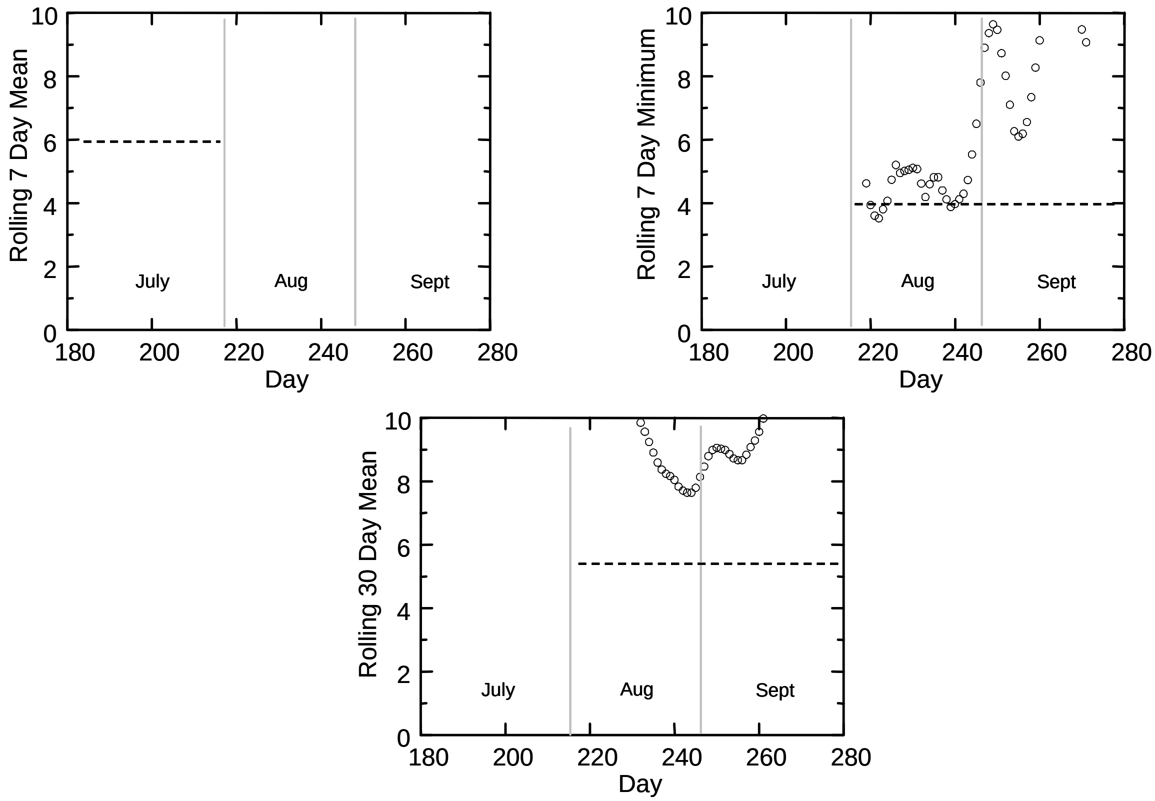


Figure 89. Results from continuous monitoring of dissolved oxygen at Churchill Woods in relation to various water quality standards for dissolved oxygen. The dashed line in each plot shows the water quality standard corresponding to the labeled y-axis and the appropriate time period.

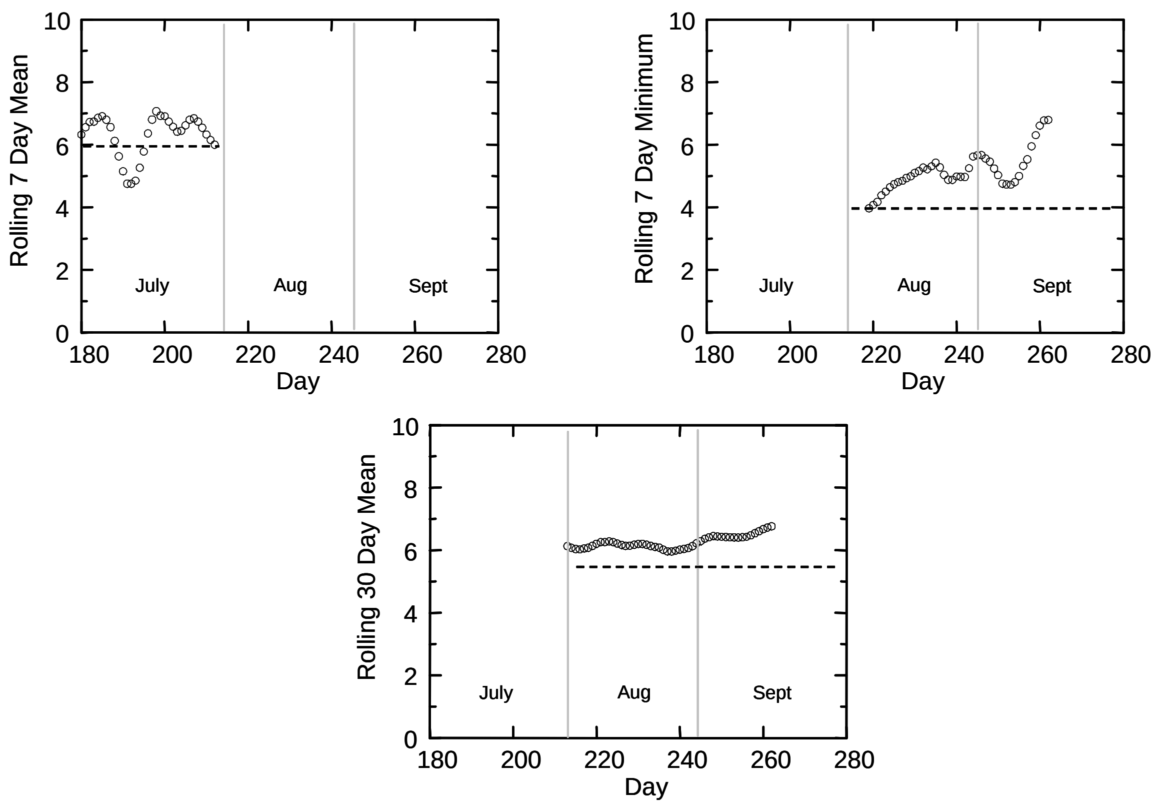


Figure 90. Results from continuous monitoring of dissolved oxygen at Butterfield Road, 2007, in relation to various water quality standards for dissolved oxygen. The dashed line in each plot shows the water quality standard corresponding to the labeled y-axis and the appropriate time period.

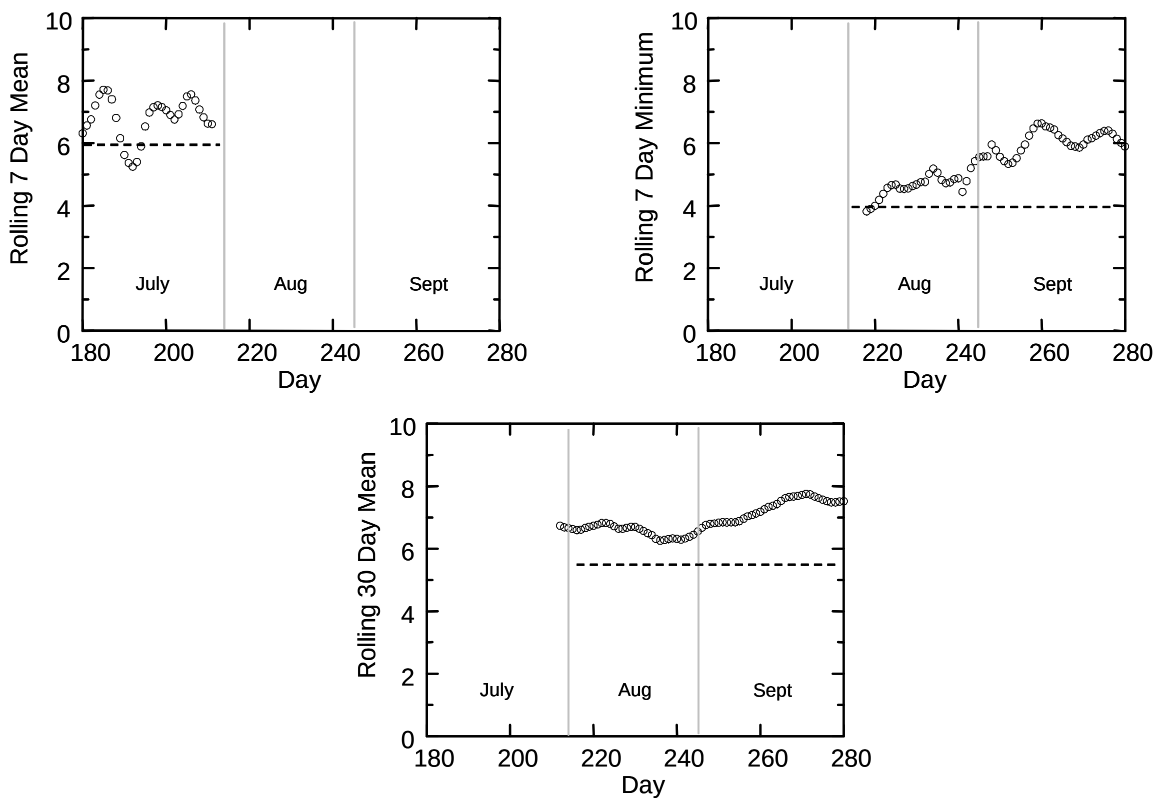


Figure 91. Results from continuous monitoring of dissolved oxygen at Hidden Lake Forest Preserve, 2007, in relation to various water quality standards for dissolved oxygen. The dashed line in each plot shows the water quality standard corresponding to the labeled y-axis and the appropriate time period.

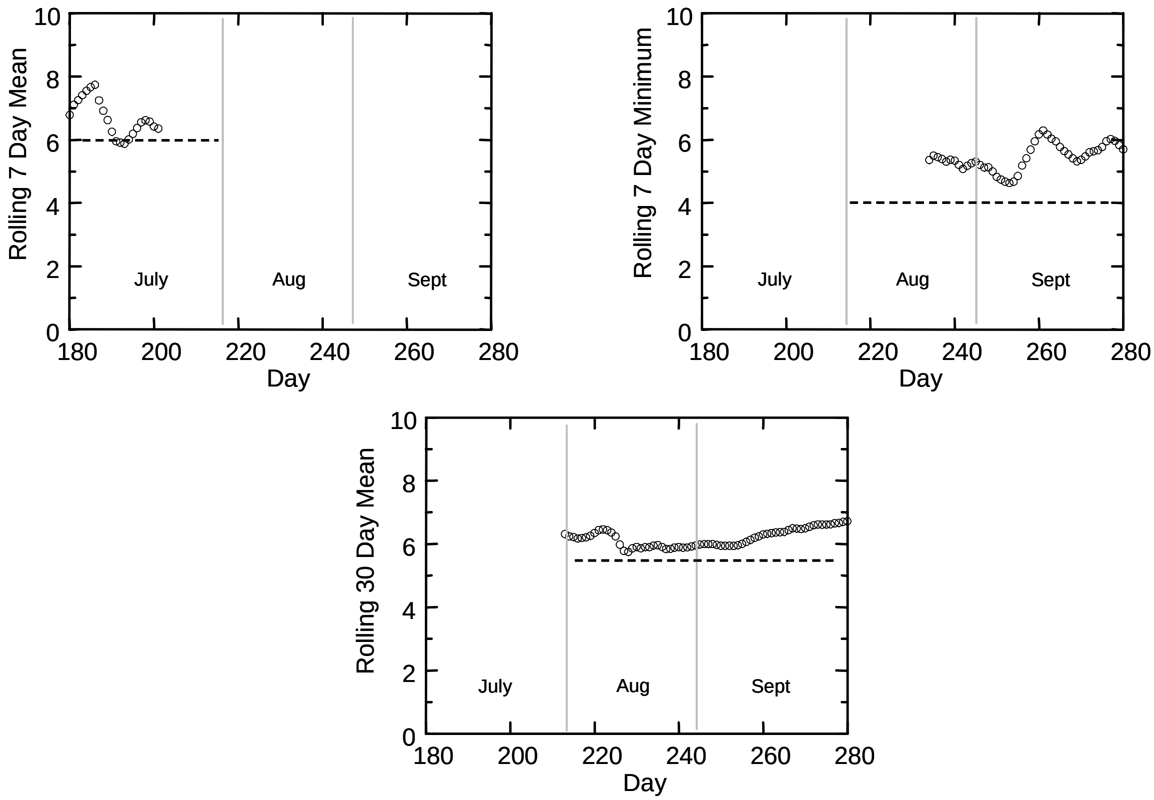


Figure 92. Results from continuous monitoring of dissolved oxygen at Hobson Road, 2007, in relation to various water quality standards for dissolved oxygen. The dashed line in each plot shows the water quality standard corresponding to the labeled y-axis and the appropriate time period.

Water Chemistry – East Branch Tributaries
Water quality in the tributaries to the East Branch appears to be largely governed by suburban and urban land uses. The highest concentrations of total dissolved solids were found in the smallest streams, coincident with the highest ammonia and BOD concentrations (Figure 93). This combination suggests that the headwaters are ephemeral or frequently intermittent such that evaporation concentrates salts and lack of flow results in a hypoxic reducing environment (hence the relatively high ammonia and BOD). Total phosphorus concentrations, were, however, present at concentrations more typical of unpolluted waters.

Sediment Chemistry – East Branch
Sediment samples collected from the East Branch were evaluated against guidelines compiled by McDonald et al. (2000) and the Ontario Ministry of Environment (1993) that list ranges of contaminant values by probable toxicity to aquatic life (Table 13). Specifically, threshold effects levels (TEL) are those where toxicity is initially apparent, and likely to affect only the most sensitive organisms. Probable effects levels (PEL) are those where toxicity is likely to be observed over range of organisms. Results for metals were also compared to statistical ranges listed for Illinois lakes by Mitzelfelt (1996).

Threshold effects levels for polycyclic aromatic hydrocarbons (PAHs) were exceeded in every sample, and probable effects levels were exceeded in all but one sample. Probable effects levels (PELs) were exceeded most frequently in and downstream from St. Joseph Creek (Figure 94). PAHs result from the incomplete combustion of gasoline, and are a component of stormwater in urban areas. The frequency with which PELs were exceeded suggest that PAH concentrations may be limiting to aquatic life. PELs for metal concentrations were not exceeded in any sample. Threshold effects levels were occasionally exceeded, but the concentrations found for most metals were normal with respect to those reported by Mitzelfelt (1996). Metals in stormwater from suburban and urban landscapes originate from roofs (zinc), automobiles and pressure treated lumber (cadmium, copper, lead and zinc), and atmospheric deposition (mercury). One detection of organochlorine pesticides (e.g., DDT and its metabolites, gamma-BHC [Lindane], endrin, chlordane, toxaphene, etc.) that exceeded the PEL for 4,4-DDE was noted at for the sample collected near Park Boulevard on the East Branch (EB12, RM 13). DDT and its metabolites may be present in sediment as a result of aerial deposition from remote sources (Shen et al. 2005), from imported fruits and vegetables (USDA 2007), and historic use (Dimond and Owen 1996).

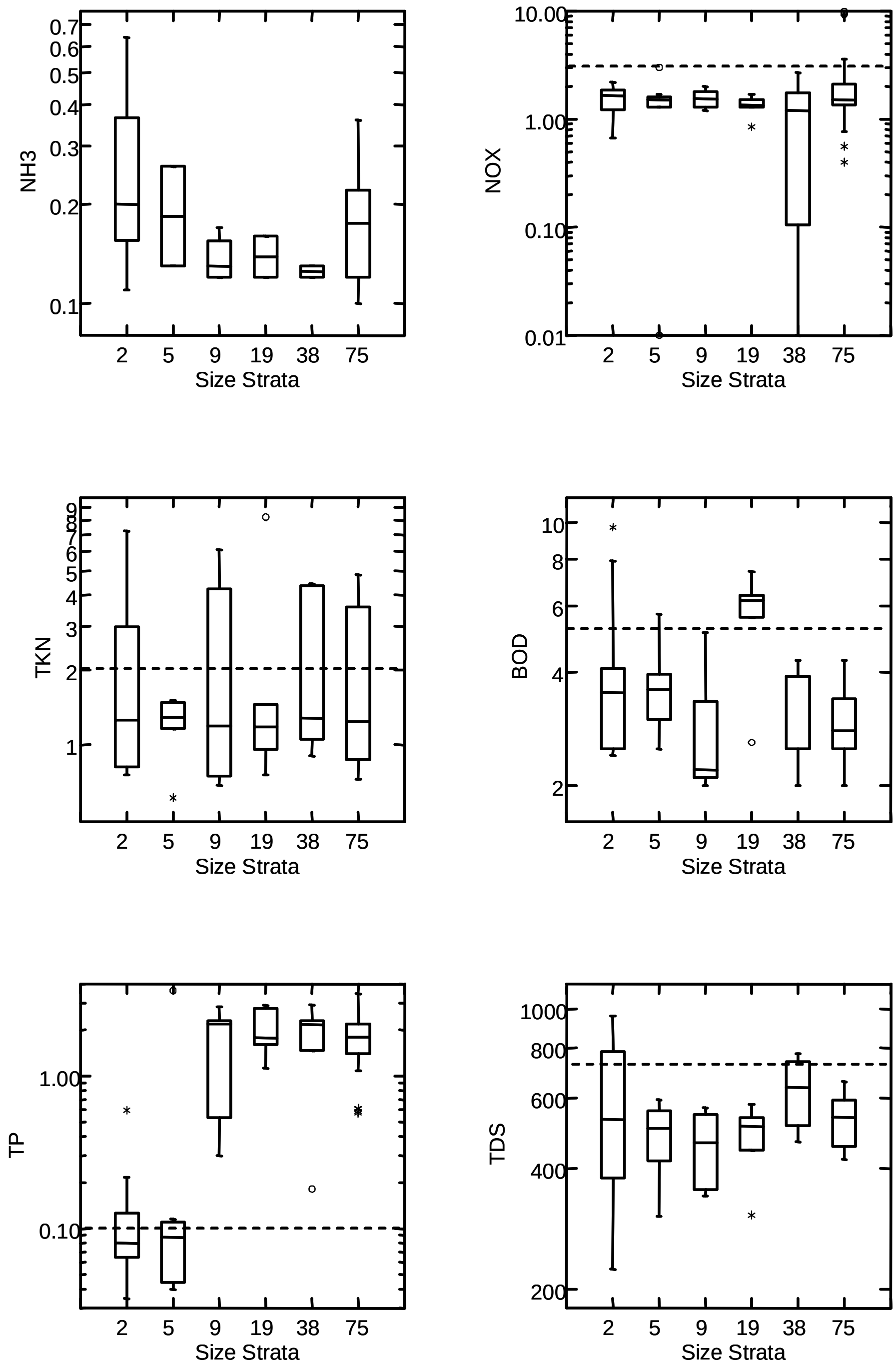


Figure 93. Concentrations of water quality parameters in samples collected from the East Branch and its tributaries stratified by drainage area. The dashed line in each plot shows the upper range of concentrations typical for unpolluted waters.

Table 14. Number of polycyclic aromatic hydrocarbons (PAHs), metals, polychlorinated biphenyls (PCBs), and pesticide detections found in sediment samples collected from the East Branch DuPage River and its tributaries, 2006, having concentrations that exceed threshold effects levels (TEL) listed in McDonald et al. (2000) or Ontario Ministry of Environment (1993).

		PAHs		Metals		PCBs		Pesticides	
Water Body	Site ID	TEL	PEL	TEL	PEL	TEL	PEL	TEL	PEL
St. Joseph Creek	07	12	6	0	0	0	0	0	0
E. Branch DuPage River	12	10	4	0	0	0	0	3	1
E. Branch DuPage River	21	10	5	1	0	0	0	0	0
E. Branch DuPage River	23	10	2	0	0	0	0	0	0
E. Branch DuPage River	26	10	0	0	0	0	0	0	0
E. Branch DuPage River	30	10	5	1	0	0	0	1	0
E. Branch DuPage River	31	12	6	1	0	0	0	2	0
E. Branch DuPage River	32	11	6	1	0	0	0	0	0
E. Branch DuPage River	33	11	6	0	0	0	0	0	0
E. Branch DuPage River	34	11	6	2	0	0	0	0	0
E. Branch DuPage River	35	12	6	0	0	0	0	0	0

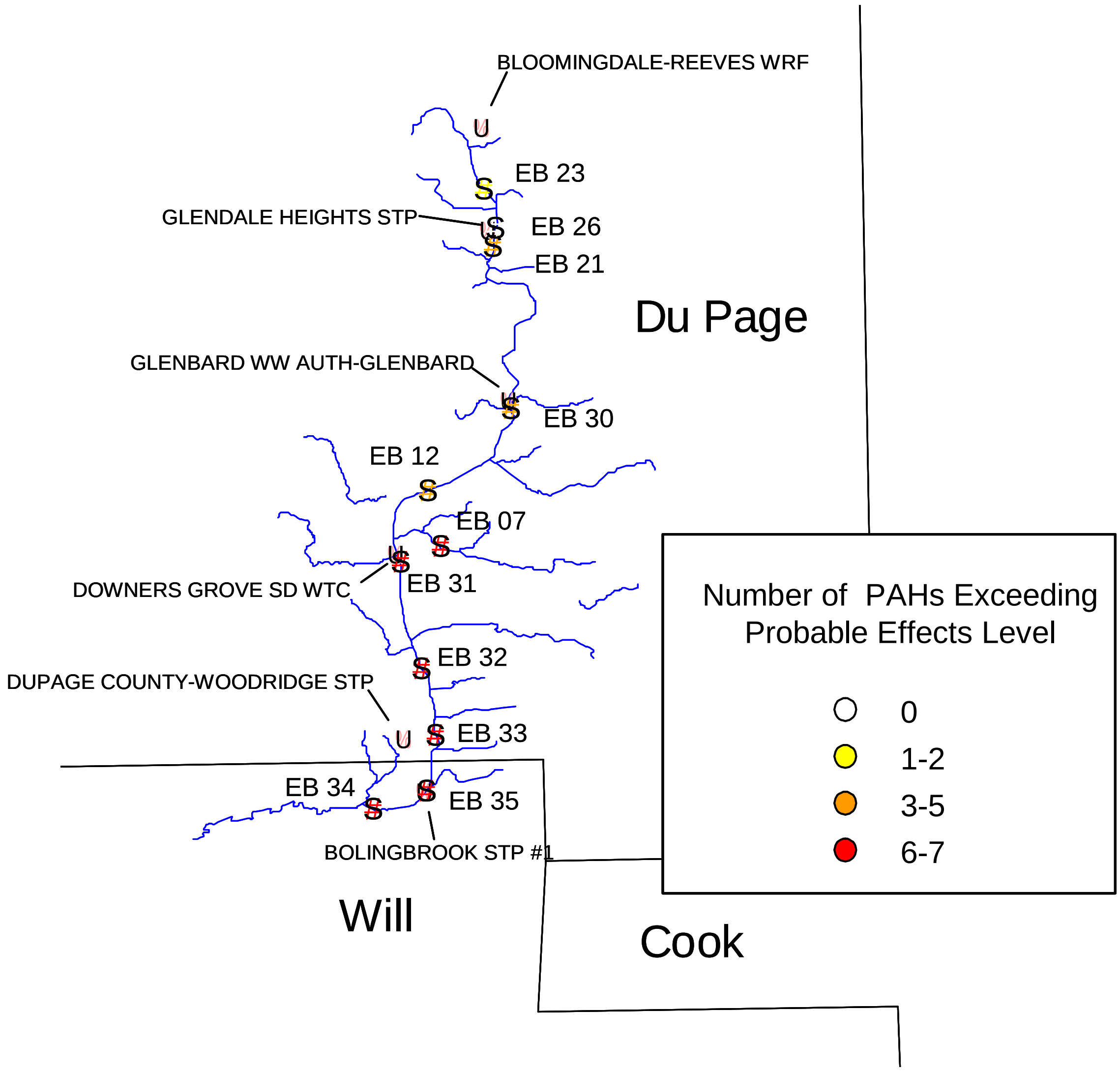


Figure 94. Locations of sediment samples collect in the East Branch watershed in relation to municipal wastewater dischargers. Samples color-coded to the number of polycyclic aromatic hydrocarbons detected at concentrations exceeding levels where negative effects on aquatic organisms are probable.

Physical Habitat Quality for Aquatic Life - East Branch

Functional riffles (i.e., those having coarse gravels and cobbles, a defined discontinuity in bed elevation, appreciable flow volume, depth and velocity) were absent at 9 of the 17 sites sampled along the East Branch mainstem because of entrenchment, impoundment and channelization (Figure 95). The two sites with the best habitat were located immediately downstream from low-head dams, likely because the sites were sediment starved. The lack of riffles and number of dams seriously comprises the habitat potential of the East Branch. Good to excellent substrates, however, were noted frequently, and likely reside buried in impounded sections. A more natural flow regime encouraged by dam removal would augment the habitat by redistributing substrates.

East Branch Tributaries

St. Joseph Creek, by dint of a hardened watershed, had the features of a modified ditch. Again, entrenchment and prevention of lateral scour defined the habitat features (Figure 96). The 22nd Street tributary, Armitage Creek, and to a lesser extent, Glencrest Creek were similarly affected by the habitat malaise wrought by stormwater in a suburban setting. The site sampled in Willoway Brook at Morton Arboretum was an oasis of excellent habitat. It had no high-influence modified attributes and was dominated by features characteristic of a natural stream. In contrast, Rott Creek, not enjoying the luxury of flowing through an arboretum, took on a decidedly modified character; again, owing to the effects of revetments and incision. The habitat at the two sites sampled in Lacey Creek was simplified to the point that the stream essentially acts as a water conveyance.

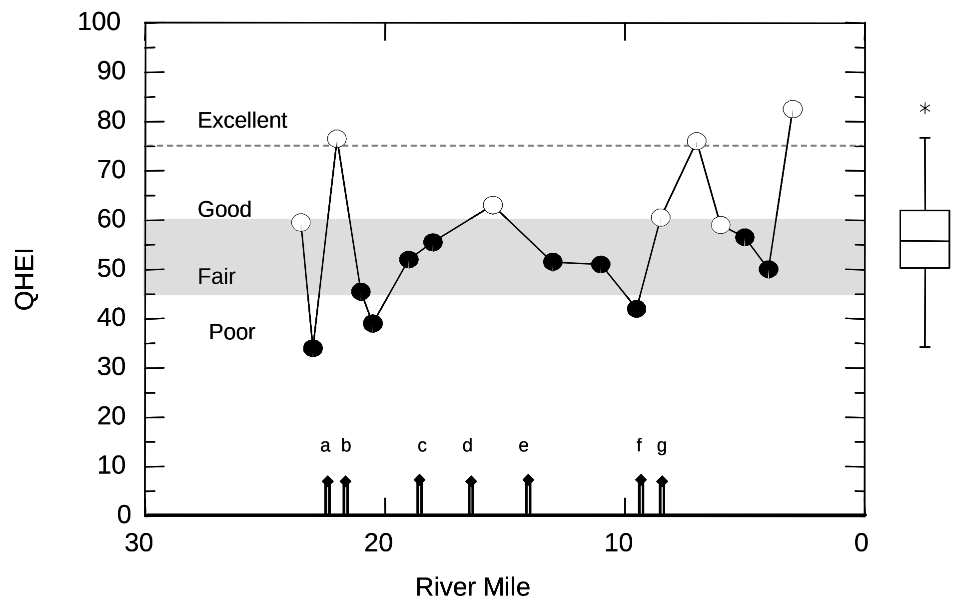


Figure 95. QHEI scores for locations sampled in the East Branch mainstem, 2007. Sites lacking riffles are shown as filled points. Dam locations are arrayed along the x-axis as diamond-tipped bars and lettered according to Figure 61. The box plot to the right of the plot shows the distribution of QHEI scores; the box bounds the 25th – 75th percentiles, the vertical line represents the median score, and whiskers show the outer range of data points. Narrative quality ranges are noted.

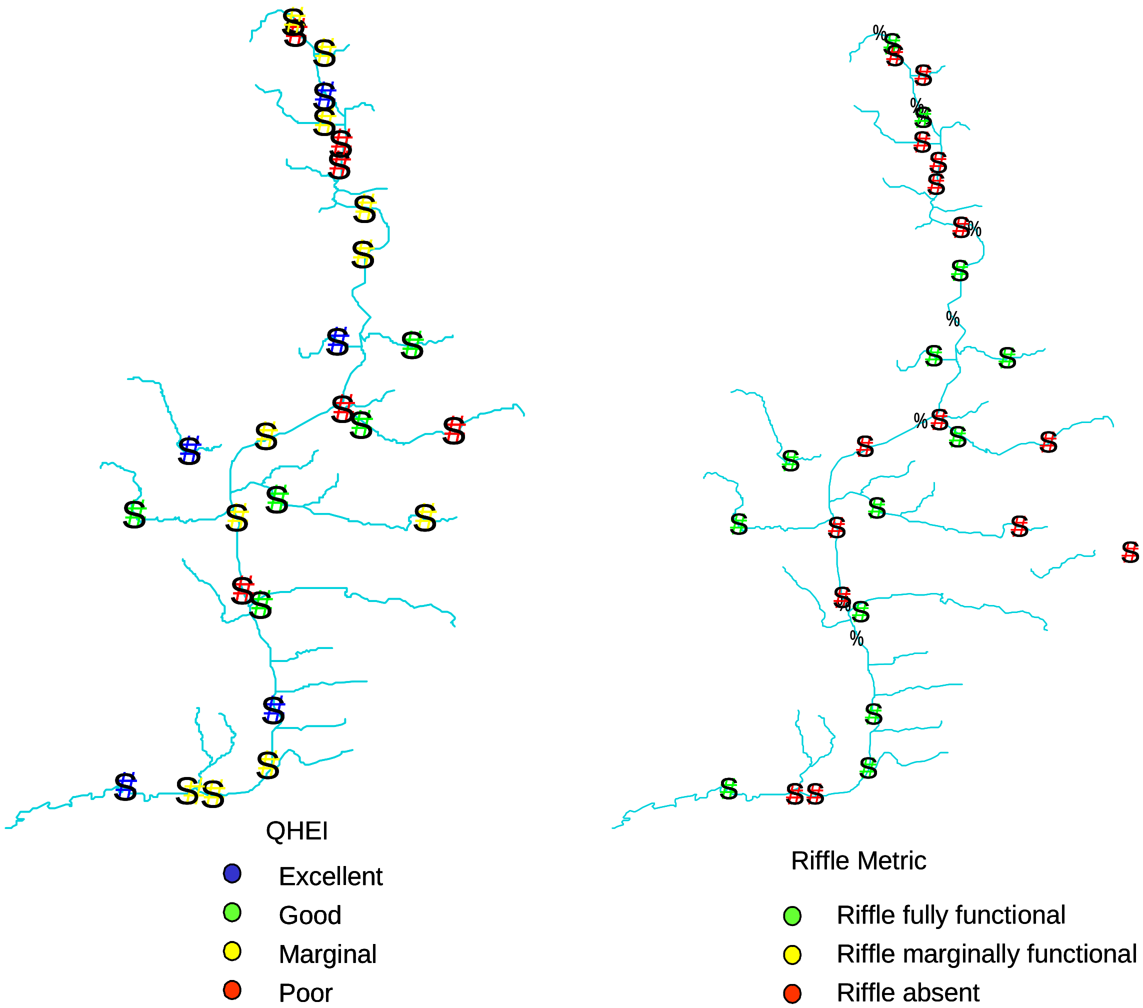


Figure 96. QHEI (left panel) and riffle metric (right panel) scores for sites sampled in the East Branch catchment, 2007. Score are color-coded by narrative ranges. Dam locations are noted as black squares in the riffle metric plot at right.

Table 13. QHEI scores and metric values for sites in the East Branch of the Dupage River watershed

Key QHEI Components

River Mile	QHEI	Gradient (ft/mile)	WWH Attributes: No Channelization or Recovered	Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Substrates	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low-Normal Overall Embeddedness	Max Depth > 40 cm	Low-Normal Riffle Embeddedness	Total WWH Attributes	MWH Attributes, High Influence: Channelized or No Recovery	Silt/Muck Substrates	No Sinuosity	Sparse/No Cover	Max Depth < 40 cm (WD, HW)	Total H.I. MWH Attributes	MWH Attributes, Moderate Influence: Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrates (Boat)	Hardpan Substrate Origin	Fair/Poor Development	Low Sinuosity	Only 1-2 Cover Types	Intermittent and Poor Pools	No Fast Current	High/Mod. Overall Embeddedness	High/Mod. Riffle Embeddedness	No Riffle	Total M.I. MWH Attributes	(MWH H.I.+1)/(WWH+1) Ratio	(MWH M.I.+1)/(WWH+1) Ratio
(95980) E. Branch DuPage River																																		
Year: 2007																																		
23.5	59.50	9.96		■				■	■		■		4		◆	◆			2	■	■			■	■				■	■		6	0.60	1.80
23.0	34.00	9.96						■			■		2	◆	◆	◆	◆		4		■		■	■	■			■	■		■	7	1.67	4.00
22.0	76.50	5.12	■	■		■	■	■	■		■		7						0		■								■	■		3	0.13	0.50
21.0	45.50	4.58		■				■	■		■		4	◆	◆	◆			3		■			■	■				■		■	5	0.80	1.80
20.5	39.00	8.11						■			■		2	◆	◆	◆	◆		4		■			■	■			■	■		■	6	1.67	3.67
19.0	43.00	2.11		■				■			■		3			◆			1		■			■	■			■	■		■	6	0.50	2.00
18.0	55.25	2.11						■	■		■	■	4		◆	◆			2	■	■			■	■			■	■			6	0.60	1.80
18.0	57.25	2.11						■	■	■	■	■	5		◆	◆			2	■	■			■	■							4	0.50	1.17
15.5	62.75	3.29		■				■	■		■		4						0	■	■			■	■				■	■		6	0.20	1.40
13.0	51.75	5.55		■				■	■		■		4		◆				1	■	■			■	■			■	■		■	7	0.40	1.80
11.0	51.00	3.55		■				■	■		■		4	◆			◆		2					■	■				■		■	4	0.60	1.40
9.5	42.00	3.55		■					■	■	■		4	◆			◆		2					■	■	■					■	4	0.60	1.40
8.5	61.00	3.17		■				■	■		■		4	◆					1					■	■				■	■		4	0.40	1.20
7.0	76.00	3.17		■		■		■	■	■	■		6						0	■					■					■		3	0.14	0.57
6.0	59.00	1.86		■				■	■		■		4		◆				1	■	■			■	■				■	■		6	0.40	1.60
5.0	57.25	1.86	■				■	■	■		■		5		◆				1		■			■					■		■	4	0.33	1.00
4.0	49.50	1.86						■	■		■		3		◆				1	■	■			■	■				■		■	6	0.50	2.00
3.0	81.75	1.86	■	■		■	■	■	■	■	■	■	9						0													0	0.10	0.10
(95982) Big Rock Creek																																		
Year: 2006																																		
11.0	92.00	8.90	■	■		■	■	■	■	■	■	■	9						0													0	0.10	0.10
3.4	91.00	19.20	■	■		■	■	■	■	■	■	■	9						0													0	0.10	0.10
(95984) Fox River																																		
Year: 2006																																		
42.7	60.25	0.00	■			■	■	■	■		■		6			◆	◆		2		■			■	■				■	■		5	0.43	1.14
8.0	78.00	0.00	■	■		■	■	■	■	■	■	■	9						0													0	0.10	0.10

Table 3. QHEI scores and metric values for sites in the East Branch of the Dupage River watershed

Key QHEI Components

River Mile	QHEI	Gradient (ft/mile)	WWH Attributes											MWH Attributes: High Influence						MWH Attributes: Moderate Influence														
			No Channelization or Recovered	Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Substrates	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low-Normal Overall Embeddedness	Max Depth > 40 cm	Low-Normal Riffle Embeddedness	**Total WWH Attributes**	Channelized or No Recovery	Silt/Muck Substrates	No Sinuosity	Sparse/No Cover	Max Depth < 40 cm (WD, HW)	**Total H.I. MWH Attributes**	Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrates (Boat)	Hardpan Substrate Origin	Fair/Poor Development	Low Sinuosity	Only 1-2 Cover Types	Intermittent and Poor Pools	No Fast Current	High/Mod. Overall Embeddedness	High/Mod. Riffle Embeddedness	No Riffle	**Total M.I. MWH Attributes**	**(MWH H.I.+1)/(WWH+1) Ratio**	**(MWH M.I.+1)/(WWH+1) Ratio**
(95985) Forked Creek																																		
Year: 2006																																		
4.4	84.00	4.38	■	■				■	■	■	■	■	7						0					■	■							2	0.13	0.38
(95987) St. Joseph Creek																																		
Year: 2007																																		
6.0	52.00	19.60		■				■			■		3	◆		◆	◆		3		■			■	■			■	■	■	■	7	1.00	2.75
4.0	59.50	3.78		■			■	■			■		4				◆		1	■	■			■				■	■	■		6	0.40	1.60
1.0	68.50	6.48		■				■		■	■	■	5	◆		◆			2					■	■			■				3	0.50	1.00
1.0	68.50	6.48		■				■		■	■	■	5	◆		◆			2					■	■			■				3	0.50	1.00
(95995) Mill Creek																																		
Year: 2007																																		
6.0	80.50	11.68	■	■		■	■	■	■	■	■	■	9						0													0	0.10	0.10
6.0	79.00	11.67	■	■		■	■	■	■	■	■	■	9						0													0	0.10	0.10
2.5	91.00	9.27	■	■		■	■	■	■	■	■		9						0													0	0.10	0.10
2.5	93.25	9.27	■	■		■	■	■	■	■	■	■	9						0													0	0.10	0.10
(95996) North MIll Creek																																		
Year: 2007																																		
6.0	46.50	2.58		■				■	■		■		4	◆					1		■			■	■				■	■		5	0.40	1.40
6.0	45.50	2.58		■				■	■		■		4	◆					1		■			■	■				■	■		5	0.40	1.40

East Branch Biological Communities - Fish

Upstream from the Churchill Woods dam, the fish community in the East Branch is essentially that of a pond: sunfish, bullhead, golden shiner, mosquito fish, and an occasional stocked walleye. Downstream from the dam, the community begins to look more like what one would expect to find in a stream: sand shiner, johnny darter, horny head chub, and rock bass were present, sometimes at high relative abundances, especially at RM 11 (EB 31, immediately downstream from the Downers Grove WWTP) where the community scored the best out of all the sites sampled in the East Branch. The other longitudinal trend in IBI scores, with respect to river mile, was a drop in the IBI scores downstream from the Bolingbrook and Woodridge WWTPs (Figure 97). Effluent ammonia concentrations in excess of permit limits were noted for both plants in 2007. Additionally, habitat in the reach was limited by lack of riffles and muck substrates.

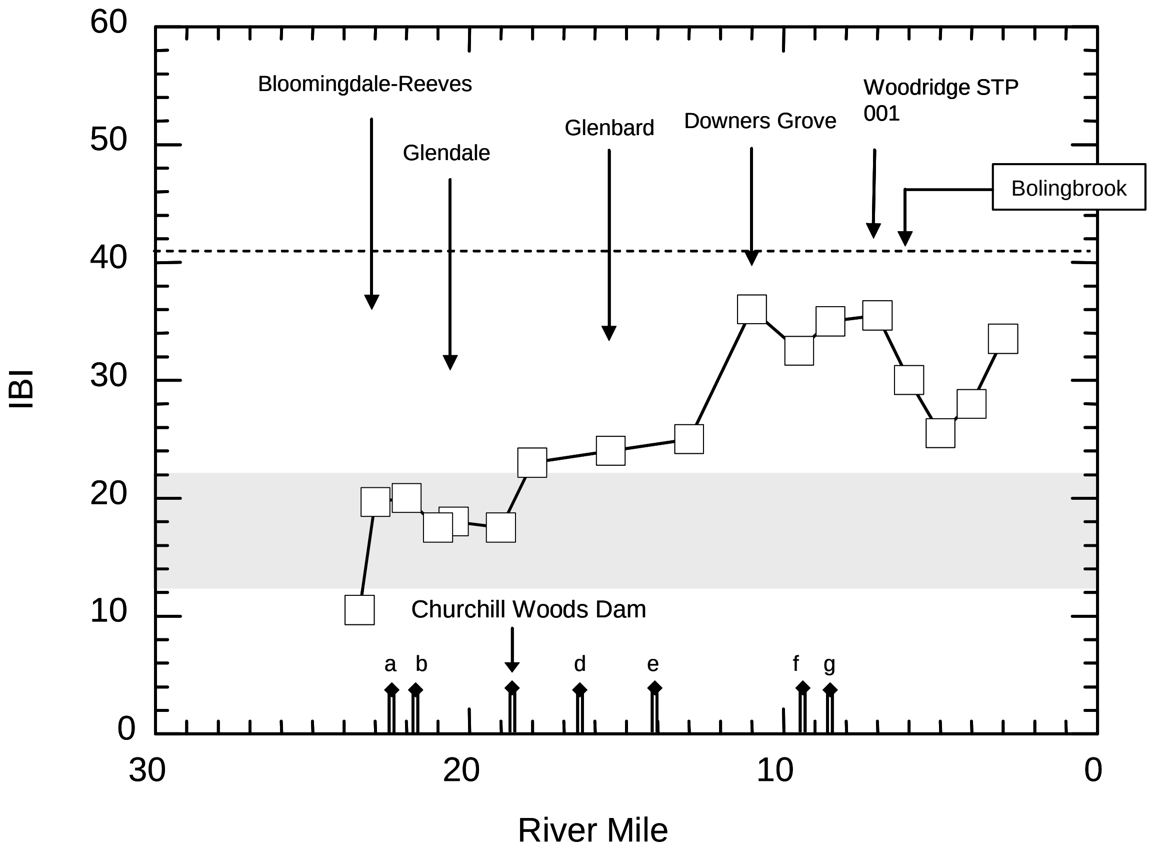


Figure 97. IBI scores for the East Branch mainstem, 2007, plotted by river mile (from the confluence with the West Branch) in relation to municipal wastewater discharges. Dam locations are arrayed along the x-axis as diamond-tipped bars with letters corresponding to those in Figure 61. Narrative quality ranges are noted on the plot.

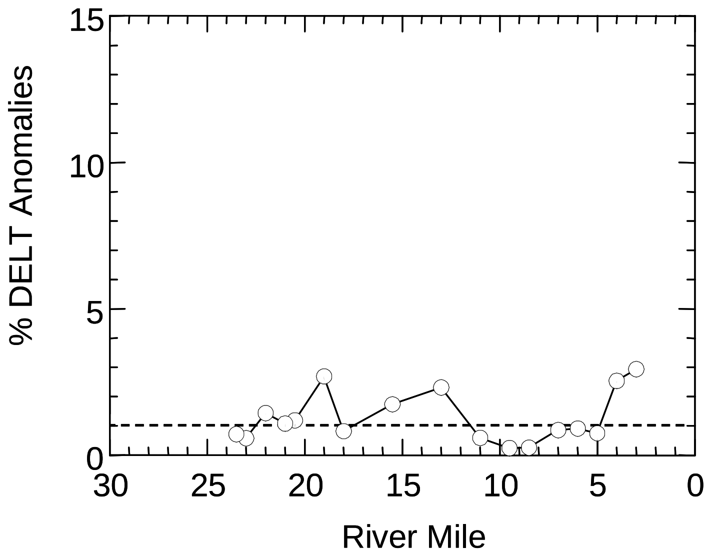


Figure 98. Percent of fish in electrofishing samples showing deformities, eroded fins or barbels, lesions, and/or tumors collected from the East Branch mainstem, 2007.

East Branch Tributaries

Willoway Brook, Glencrest Creek, the 22nd Street tributary, Lacey Creek at Saratoga Avenue, and the upper two sites on St. Joseph Creek supported fish communities dominated by centrarchids, typically bluegill and green sunfish, and fathead minnows. The lower sites sampled on Lacey and St. Joseph Creek apparently had their respective fish communities augmented by proximity to the East Branch mainstem. Rott Creek possessed a stream fish assemblage, albeit a rudimentary one, containing mostly creek chubs, stonerollers, white suckers and bluntnose minnows.

East Branch Biological Communities - Macroinvertebrates

A distinct longitudinal upstream to downstream trend in MIBI scores was noted for the East Branch (Figure 99), and it appears to relate strongly to BOD5 concentrations. The major source of oxygen demanding substances did not appear to be publicly owned treatment works (see Figure 93); more likely the sources were the impoundments on the mainstem, especially the one formed by the Churchill Woods dam, and the numerous ponds that lie adjacent to the channel for the reach upstream from RM 15.

The MIBI scores downstream from the Bolingbrook STP, and especially the one downstream from the Woodbridge STP via Crabtree Creek, were unusually low relative to sites in the reach immediately upstream, and disproportionate to any variation in local habitat quality. The tolerance index score for the site downstream from Crabtree Creek was 9.0 (on a scale of 0 to 10, from sensitive to highly tolerant of pollution), suggesting acute toxicity. Effluent concentrations of ammonia-nitrogen in excess of permit limits were noted for both plants in 2007.

East Branch Tributaries

None of the East Branch tributaries had MIBI scores above the Poor narrative range (Figure 100). The highest score was reported for Rott Creek, but other than a weak association with BOD5, the scores in the tributaries were so uniformly poor as to be generally uncorrelated with any water quality parameter. Proximity to the East Branch mainstem was as good or better a predictor of MIBI scores and submetrics as any habitat or water chemistry variable. This suggests stormwater, and its attendant sequelae, is the limiting factor for biological communities in the East Branch tributaries.

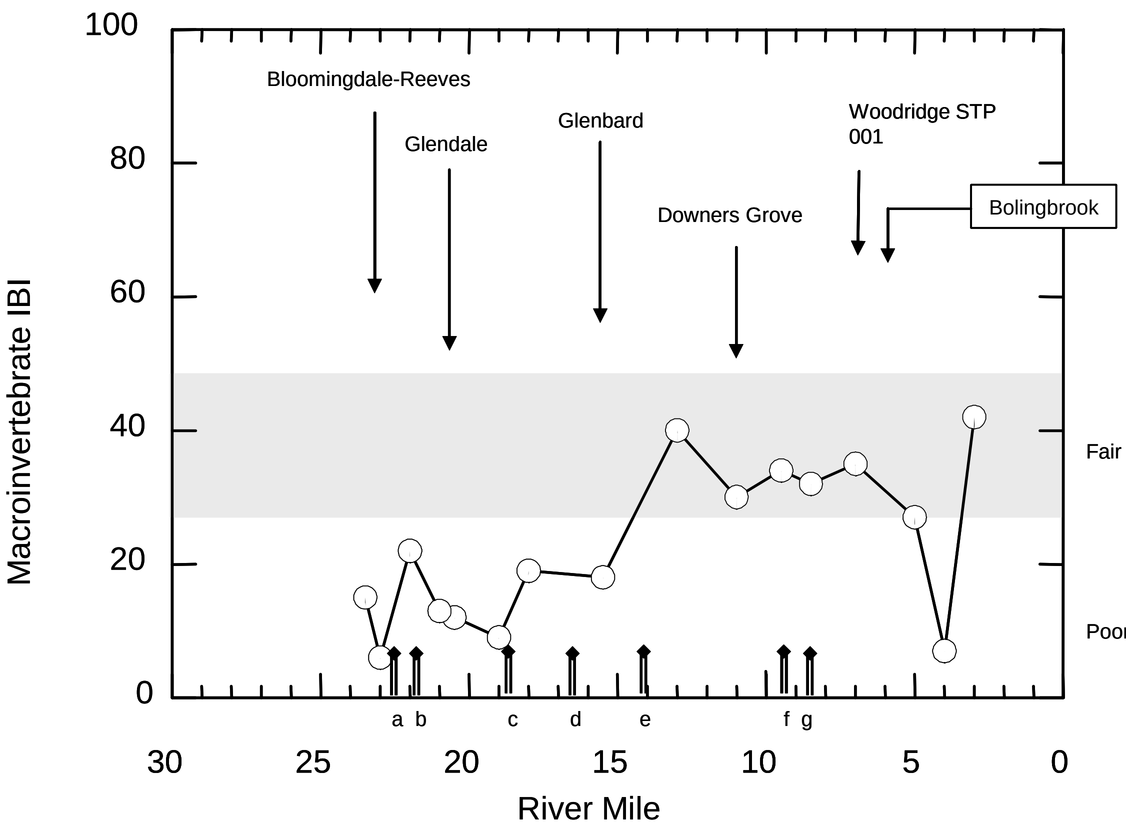


Figure 99. Macroinvertebrate IBI (MIBI) scores for the East Branch mainstem, 2007, plotted by river mile (from the confluence with the West Branch) in relation to municipal wastewater discharges. Dam locations are arrayed along the x-axis as diamond-tipped bars with letters corresponding to those in Figure 61. Narrative quality ranges are noted on the plot.

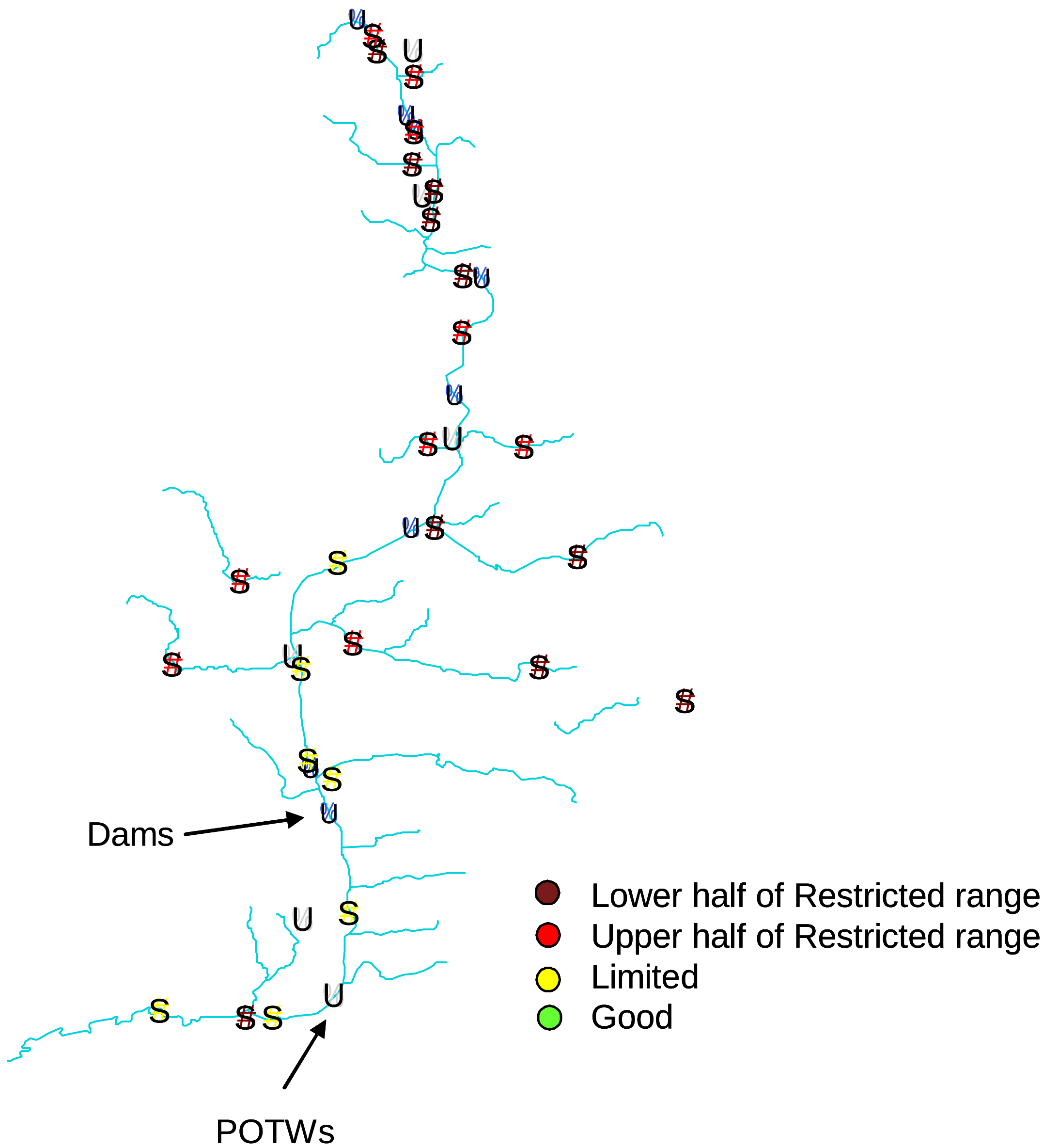


Figure 100. MIBI scores for sites sampled in the East Branch DuPage River, 2007, plotted by narrative ranges. The locations of POTWs and dams are noted.

Biological and Water Quality – West Branch DuPage

The West Branch DuPage River watershed covers 128 square miles of DuPage, Cook and northern Will Counties. The main stem of the West Branch measures 34 linear miles in length, and joins the East Branch of the DuPage River on the Bolingbrook municipal line to form the DuPage River, a tributary to the Des Plains River. There are twenty-one municipalities in the watershed, and seven publicly owned treatment plants discharge to the West Branch. There are no combined sewer overflows in the watershed. Land use in the basin is dominated by urban and residential land uses, each respectively making up 23 and 44 percent of the land area. As was noted for the Salt Creek and East Branch watersheds, levels that high are likely to be very important determinants of water and biological quality, and therefore, must be considered as the background condition against which to judge the results of this study, and in evaluation of potential stressors.

Biological community index scores (Table 14) measured throughout the West Branch watershed were generally in the lower half of the quality range for both macroinvertebrates and fish, and, in keeping with land use being the strongest determinant of condition, the lowest scores for both indicators were recorded in the small headwaters (Figure 101). However, macroinvertebrate community scores exceeded the minimum quality standard at six sites in larger streams. Also, the fish community in the lower 6.5 mile reach of the mainstem scored in the upper half of the index range.

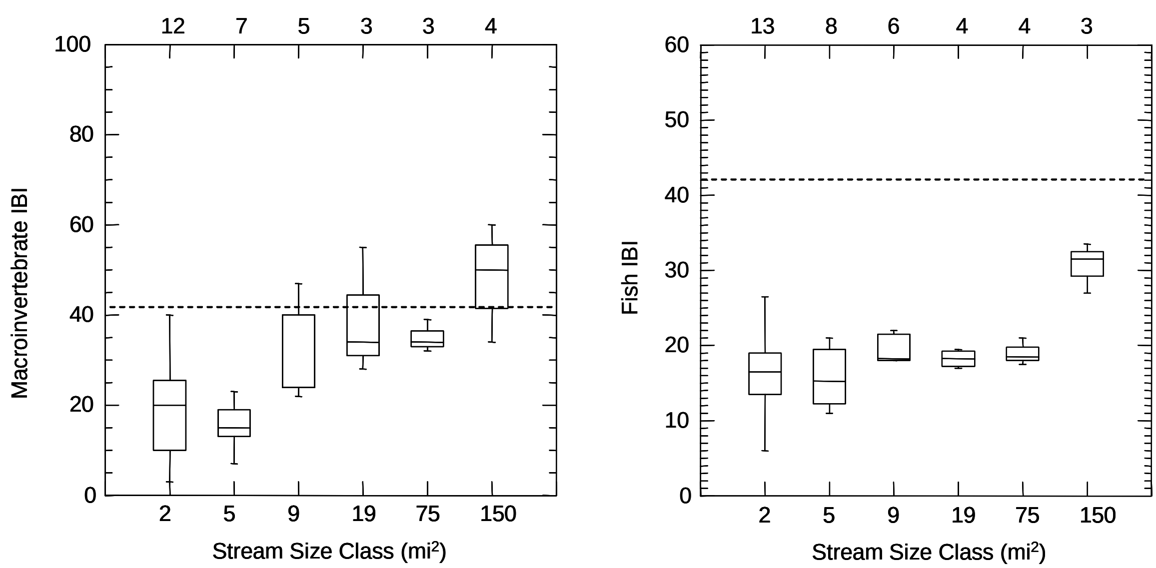


Figure 101. Distributions of macroinvertebrate and fish Index of Biotic Integrity (IBI) scores for sites sampled in 2007 from the Salt Creek basin. Results are stratified by drainage area. The dashed line in each plot shows the minimum score needed for the indicator to meet basic biological quality standards.

The influence of treated municipal effluent in the West Branch is evident in the jump in total phosphorus concentrations going from the smallest headwaters (i.e., < 2 mi^2) to the next size interval (i.e., > 5 mi^2; Figure 102). In contrast, concentrations of ammonia-nitrogen did not increase between the size categories, and were consistently less than 1.0 mg/l, especially in the larger streams receiving treated effluent. As with Salt Creek and the East Branch, this suggests that treated effluent is not a major determinant of biological quality in the West Branch watershed.

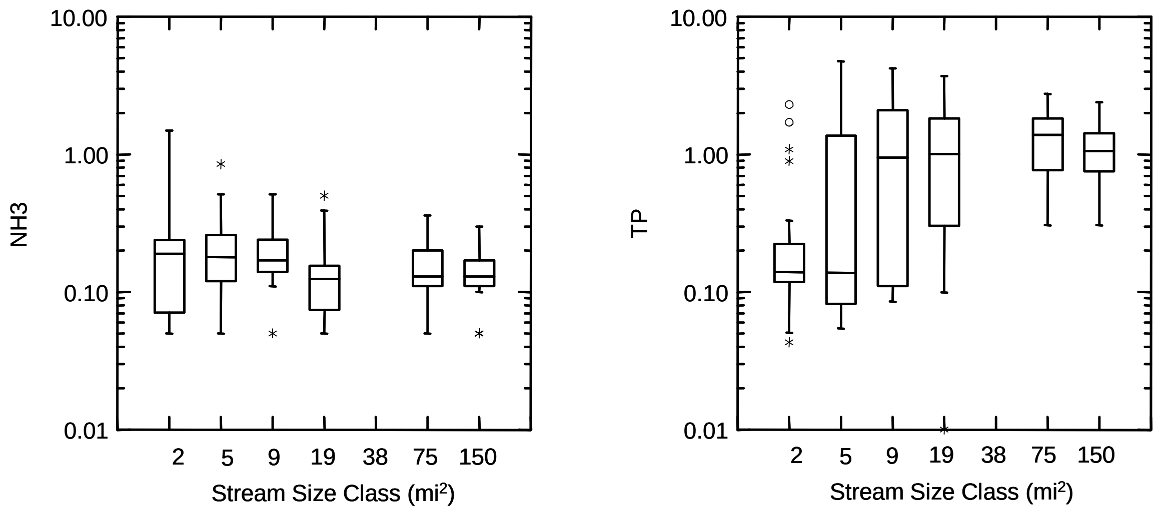


Figure 102. Concentrations (mg/l) of ammonia-nitrogen (NH3) and total phosphorus (TP) stratified by drainage area for sites sampled in the West Branch DuPage watershed, 2006.

Table 16. Attainment status of sites sampled in the West Branch DuPage River drainage, 2006. Status is based on the performance of both the macroinvertebrate IBI (MIBI) and fish IBI indicators. The Qualitative Habitat Evaluation Index (QHEI) rates habitat quality on a scale of 12 to 100, and Modified Index of Well-being (MIWb) gauges fish abundance and diversity on a scale of 0 to 12.

River Mile	Site ID	QHEI	MIBI	Fish IBI	MIWb	CWA Goal Attainment	Drain Area
95-900	W. Br. DuPage River						
34.00	WB30	42.0	18.0	13.5		Non	2.0
31.90	WB95	58.0	19.0	13.0		Non	5.0
31.60	WB29	58.5	7.0	11.5		Non	5.0
30.10	WB112	64.5	15.0	19.5		Non	5.0
28.70	WB91	60.0	22.0	22.0		Non	9.0
27.40	WB92	63.0	24.0	18.0		Non	9.0
25.60	WB25	54.0	24.0	21.5		Non	9.0
21.70	WB128	73.5	34.0	17.0		Non	19.0
21.30	WB115	58.5		19.0		(Non)	19.0
19.20	WB21	82.5	55.0	19.5		Partial	19.0
16.00	WB127	68.5		21.0	6.8	(Non)	39.0
13.60	WB16	40.5	32.0	18.5	6.8	Non	40.0
11.70	WB130	62.0	34.0	18.5	6.6	Non	50.0
8.60	WB125	53.5	39.0	17.5	6.5	Non	70.0
8.00	WB131	76.5	34.0	27.0	7.8	Non	76.0
6.30	WB126	74.5	51.0	33.5	7.7	Partial	96.0
4.20	WB124		60.0	31.5	7.9	Partial	120.0
0.85	WB12	64.0	49.0			(Full)	150.0
95-902	Trib to W. Br. DuPage River						
0.30	WB22	32.5	27.0	14.0		Non	2.0
95-904	Trib to W. Br. DuPage River						
1.00	WB27	16.0	27.0	12.0		Non	2.0
95-905	Trib to W. Br. DuPage River						
0.15	WB28	32.5	24.0	14.3		Non	2.0
95-906	Trib to W. Br. DuPage River						
2.20	WB93	39.0	9.0	6.5		Non	2.0
1.90	WB94	42.0	16.0	6.0		Non	2.0
0.90	WB26		23.0	19.0		Non	1.0

Table 16. Continued.

River Mile	Site ID	QHEI	MIBI	Fish IBI	MIWb	CWA Goal Attainment	Drain Area
95-910	Kress Creek						
5.10	WB05	40.0	19.0	11.0		Non	5.0
2.70	WB04		40.0	18.0		Non	9.0
0.50	WB06	76.0	28.0	17.5		Non	19.0
95-920	Ferry Creek						
2.80	WB08		3.0	16.5		Non	2.0
0.70	WB10		40.0	21.0		Non	0.0
95-925	W. Br. Ferry Creek						
0.25	WB09	58.5	14.0	15.0		Non	5.0
95-930	W. Br. Cress Creek						
0.20	WB11	66.5	11.0	26.5		Non	2.0
95-940	Bremme Creek						
0.25	WB13	45.0				Non	2.0
95-950	Spring Brook						
3.30	WB15	43.0	7.0	19.0		Non	2.0
3.00	WB90	67.0		16.5		Non	2.0
0.75	WB14	76.5		19.5		Non	5.0
95-960	Winfield Creek						
5.40	WB19	41.0	22.0	16.5		Non	2.0
3.50	WB18	41.0	12.0	15.5		Non	5.0
0.40	WB17			18.0		Non	9.0
95-970	Klein Creek						
3.60	WB23	52.5	23.0	21.0		Non	5.0
1.00	WB20	67.5	47.0	18.5		Partial	9.0

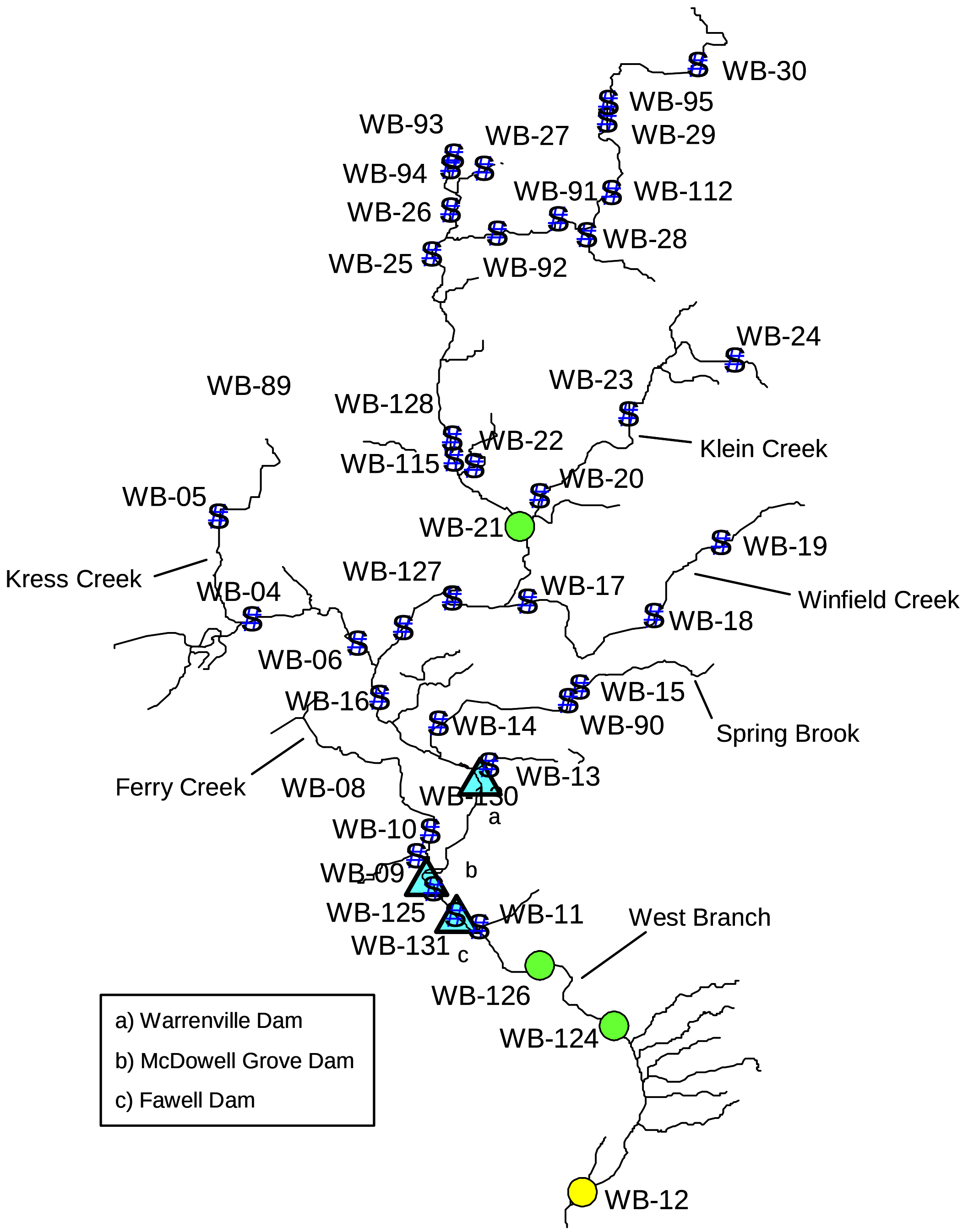


Figure 103. Locations and identification of sites sampled in the West Branch DuPage drainage referenced in Table 2. Sites that partially meet the Illinois EPA aquatic life goal for general use waters are shaded green.

Table 17. Site location table for the West Branch DuPage survey area (shown in Figure 103). River mile for a particular stream is measured as the distance upstream from its confluence with a receiving body. Samples are as follows: C, water chemistry; Co, water chemistry with a scan for organic pollutants; D, automated data logger for dissolved oxygen; F, fish community, M, benthic macroinvertebrate community; S, sediment chemistry.

Site ID	River Mile	Samples	Location or Landmark	Latitude	Longitude
95-900		*W. Branch DuPage R.*			
WB-30	34.00	C, F, M	Ust Braintree Drive, Schaumburg, Ill	42.0106	-88.1114
WB-95	31.90	Co, F, M, S	Ust Longmeadow Ln., Hanover Park, Ill	42.0007	-88.1360
WB-29	31.60	Co, F, M, S	Ust Walnut Ave., WWTP, Hanover Park, Ill	41.9959	-88.1363
WB-112	30.10	C, D, F, M	Dst SR 20, behind Denny's, Hanover Park, Ill	41.9765	-88.1350
WBAD	29.90	D	Arlington Drive	41.9750	-88.1386
WB-91	28.70	Co, F, M, S	Ust County Farm Road, Hanover Park, Ill	41.9694	-88.1496
WB-92	27.40	Co, F, M, S	Dst Bartlett WWTP, 700' Dst NPDES, Bartlett, Ill	41.9658	-88.1665
WB-25	25.60	C, F, M, S	Dst Struckman Blvd., Bartlett, Ill	41.9601	-88.1844
WB-128	21.70	Co, F, M, S	Dst St. Charles Rd, W. Chicago, Ill	41.9111	-88.1789
WB-115	21.30	Co, F, S	Ust Great Western Trail, Timber Ridge Forest	41.9059	-88.1786
WB-21	19.20	C, F, M, S	Ust Geneva Rd. West Chicago, Ill	41.8882	-88.1609
WB-127	16.00	Co, F, S	Morningside Drive, Ust W. Chicago WWTP	41.8687	-88.1790
WB-16	13.60	Co, F, M	Ust Mack Rd at dog park, Warrenville, Ill	41.8424	-88.1986
WB-130	11.70	C, F, M, S	Ust Braintree Drive, Schaumburg, Ill	42.0106	-88.1114
WBMG	9.10	D	McDowell Grove	41.7959	-88.1873
WB-125	8.60	C, F, M, S	Adj to intersection of Raymond Dr/Redfield Rd, Ust	41.7915	-88.1841
WB-131	8.00	C, F, M, S	Dst Fawell dam, Ust Ogden Ave. Naperville, Ill	41.7847	-88.1781
WB-126	6.30	Co, F, M, S	Adj.to Centennial Park/ Jackson Ave., Naperville, Ill	41.7711	-88.1556
WB-124	4.20	Co, F, M, S	Pioneer Park, Naperville, Ill	41.7532	-88.1334
WB-12	1.00	Co, F, M, S	Knoch Knolls Park, Naperville, Ill	41.7124	-88.1418
WB-116		Co	(did not do, under construction)	41.8611	-88.1925
95-902		*Trib to W.B. DuPage*			
WB-22	0.30	C, F, M	Adjacent to bike path in Prairie Preserve, east of mai	41.9040	-88.1730
95-903		*Trib to W.B. DuPage*			
WB-26	0.90	C, F, M	Dst Stearns Road-Hawk Hollow F.P.	41.9719	-88.1792
95-904		*Trib to W.B. DuPage*			
WB-27	0.15	C, F, M	Ust Coral Avenue	41.9830	-88.1702

Table 17. Continued.

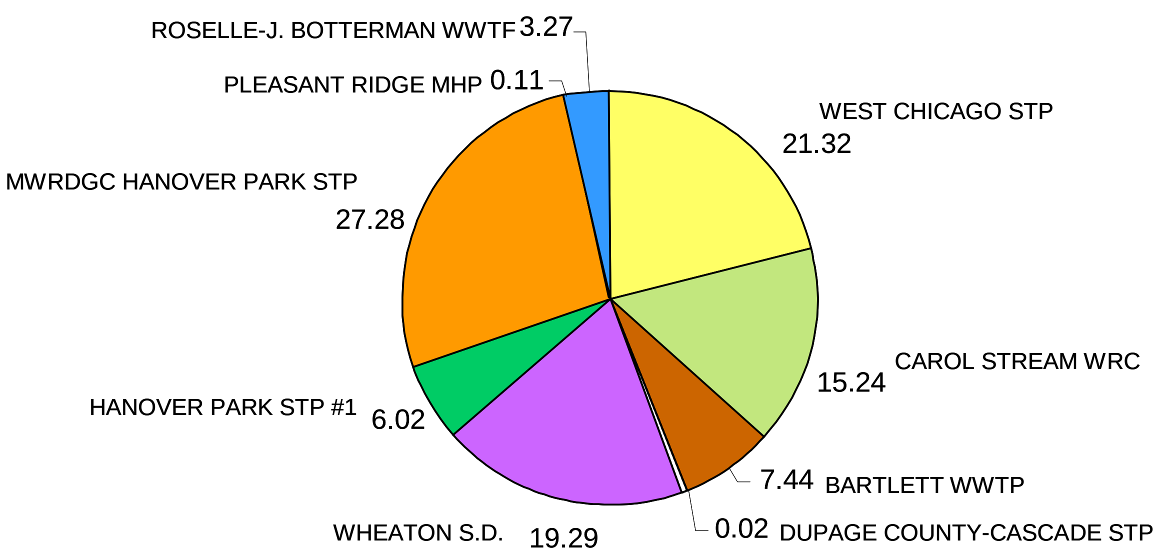
Site ID	River Mile	Samples	Location or Landmark	Latitude	Longitude
95-905		*Trib to W.B. DuPage*			
WB-28	0.15	C, F, M	Dst Schick Rd behind landfill	41.9653	-88.1420
95-906		*Trib to W.B. DuPage*			
WB-93	2.20	Co, F, M, S	Dst Devon Ave adj. to Leiseburg Park	41.9861	-88.1782
WB-94	1.90	Co, F, M, S	Dst Amhurst Drive and Bartlett WWTP	41.9833	-88.1796
95-910		*Kress Creek*			
WB-05	5.10	C, F, M	Adj. Kress Rd. Dst Prairie Path bike path	41.8906	-88.2431
WB-04	2.70	Co, F, M	Fermi Lab compound	41.8631	-88.2337
WB-06	0.50	C, F, M	Ust Intersection of Joliet and Wilson St bridge	41.8568	-88.2047
95-920		*Ferry Creek*			
WB-08	2.80	C, F, M	Dst SR 59 bridge @ Cingular pkg lot	41.8906	-88.2431
95-925		*W. Br. Ferry Creek*			
WB-10	1.50	C, F, M	Ust Ferry Rd. Warrensville, Ill	41.8068	-88.1848
WB-09	0.25	C, D, F, M	Dst Raymond Ave, Naperville, Ill	41.8005	-88.1885
95-930		*Cress Creek*			
WB-11	0.20	C, F, M	Dst 5th Ave. bridge	41.7816	-88.1717
95-940		*Bremme Creek*			
WB-13	0.25	C, F	Dst Winfield Drive	41.8245	-88.1686
95-950		*Spring Brook*			
WB-15	3.30	Co, F, M, S	Ust Wheaton WWTP Sanitary discharge	41.8452	-88.1436
WB-90	3.00	Co, F, S	Dst Mack Rd_WWTP at Allen Park, Wheaton, Ill	41.8417	-88.1470
WB-14	0.75	C, F	Behind Maintenance Bldg, Blackwell FP,	41.8354	-88.1825
95-960		*Winfield Creek*			
WB-19	5.40	C, F, M	At St Mark's Catholic Church	41.8834	-88.1048
WB-18	3.50	C, F, M	End of Liberty St. at Emerson Elementary School,	41.8644	-88.1233
WB-17	0.40	C, F	Ust Winfield Rd. in Creekside Park, Winfield, Ill	41.8679	-88.1582
95-970		*Klein Creek*			
WB-24	6.10		Dst Schmale Rd, Glendale Hts, Ill. NO WATER	41.9320	-88.1013
WB-23	3.60	C, F, M	Ust Illini Drive, Armstrong Park, Carol Stream, Ill	41.9178	-88.1305
WB-20	1.00	C, F, M	Klien Creek Farm, W. Chicago, Ill	41.8961	-88.1547

Pollutant Loadings – West Branch

The West Branch DuPage River can be an effluent dominated stream during the summer base-flow period of July through October. For example, effluent composed between 30 and 60 percent of the stream flow between August and October of 2007. Effluent quality data from major dischargers in the West Branch watershed (Table 16) were evaluated against permit limits to gauge the relative performance of each plant, especially with respect to plant flows (the amount of effluent leaving the plant) relative to treatment capacity, and concentrations of several key effluent constituents: bio-chemical oxygen demand (cBOD5), total suspended solids (TSS) and ammonia nitrogen (NH3-N).

Table 18. Publicly owned sewage treatment plants that discharge to the West Branch DuPage River watershed. DAF is design average flow, DMF is design maximum flow. The accompanying figure shows the relative contribution of each plant as a percentage of the average effluent volume for September, 2007.

Npid	Fnms	DAF MGD	DMF MGD	Receiving Stream	Longitude	Latitude
IL0036137	MWRDGC Hanover Park STP	12	22	West Branch	-88.1361	42.0008
IL0048721	Roselle-J. Botterman WWTF	1.22	4.6	West Branch	-88.1139	41.9822
IL0034479	Hanover Park STP #1	2.42	8.68	West Branch	-88.1386	41.9722
IL0027618	Bartlett WWTP	3.68	5.15	West Branch	-88.1650	41.9664
IL0026352	Carol Stream WRC	6.5	13	Klein Creek	-88.1353	41.9094
IL0028428	Dupage County-Cascade STP	.0058	NA	West Branch	-88.1783	41.9011
IL0037028	Pleasant Ridge MHP	.027	NA	Klein Creek	-88.1542	41.8889
IL0023469	West Chicago STP	7.64	20.3	West Branch	-88.1906	41.8642
IL0031739	Wheaton S.D.	8.9	19.1	Spring Brook	-88.1450	41.8447



MWRDGC HANOVER PARK [IL0036137] The design average flow for the treatment facility is 12 MGD and the design maximum is 22 MGD. The 10-year recurrent 7-day low flow (Q7/10) of the receiving stream is 0 cfs. Median annual flows from the plant from 2001 to 2007 were less than the design average, as were third quarter 95^{th} percentile flows (Figure 104). Of 267 excess flows reported between 1998 and 2007, 72 occurred when the flows from the plant were less than the design average, all but one of those events happened prior to 2003. Coincidentally, the frequency and magnitude of excess plant flows has decreased over time, such that only five have been reported since 2004 (Figure 104). Effluent quality has consistently met permit limits for NH3, BOD5, TSS and fecal coliforms between 2001 and 2007 (Figure 105). Concentrations of nitrate nitrogen (NO3N) and total phosphorus (TP) in the plant effluent are high relative to that found in unpolluted waters (Figure 106).

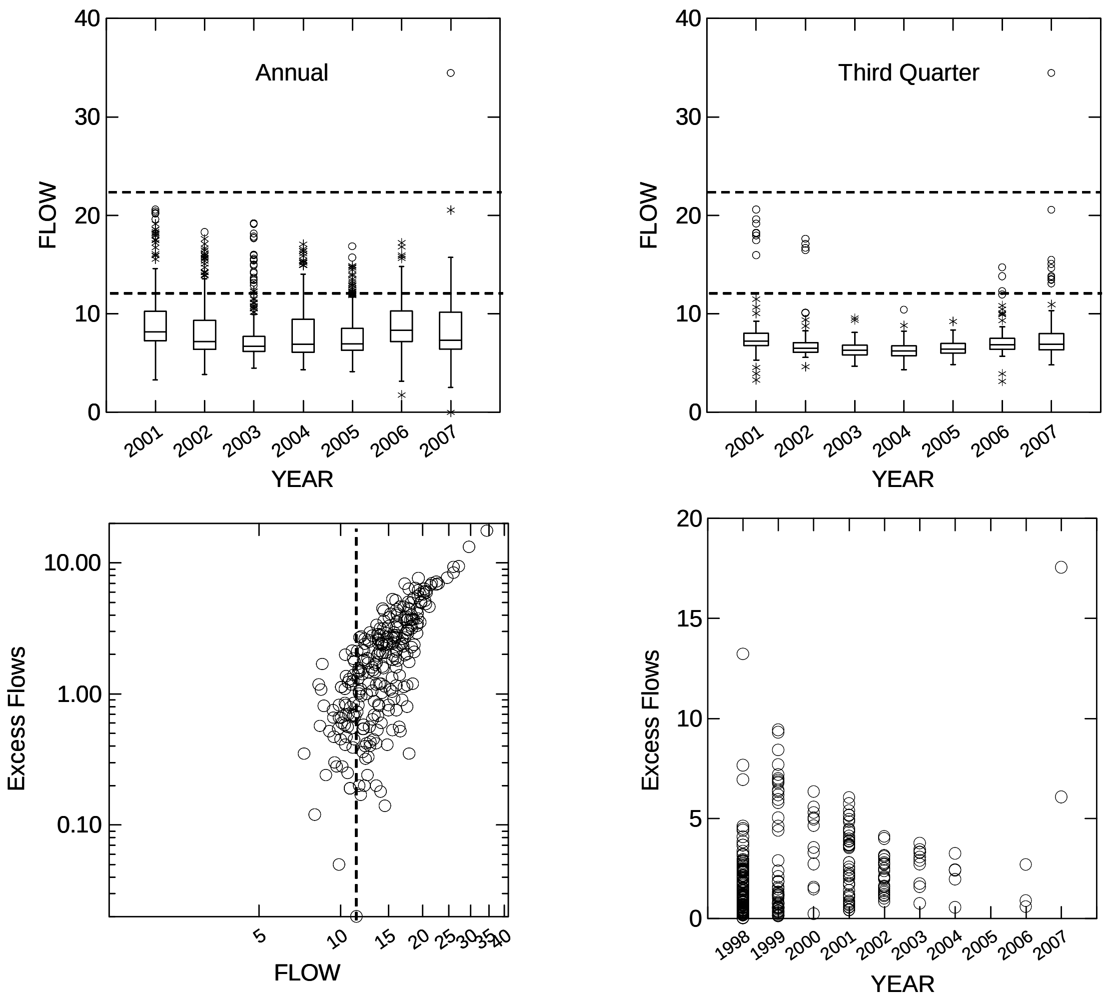


Figure 104. Annual and third quarter effluent flows (top panel) for the MWRDGC Hanover Park WWTP, 2001 – 2007, in relation to the design maximum and design average (dashed lines). Lower panels, left, excess flows from the plant as a function of plant flow and in relation to the design average; right, excess flows plotted by year. All flow values are in millions of gallons per day.

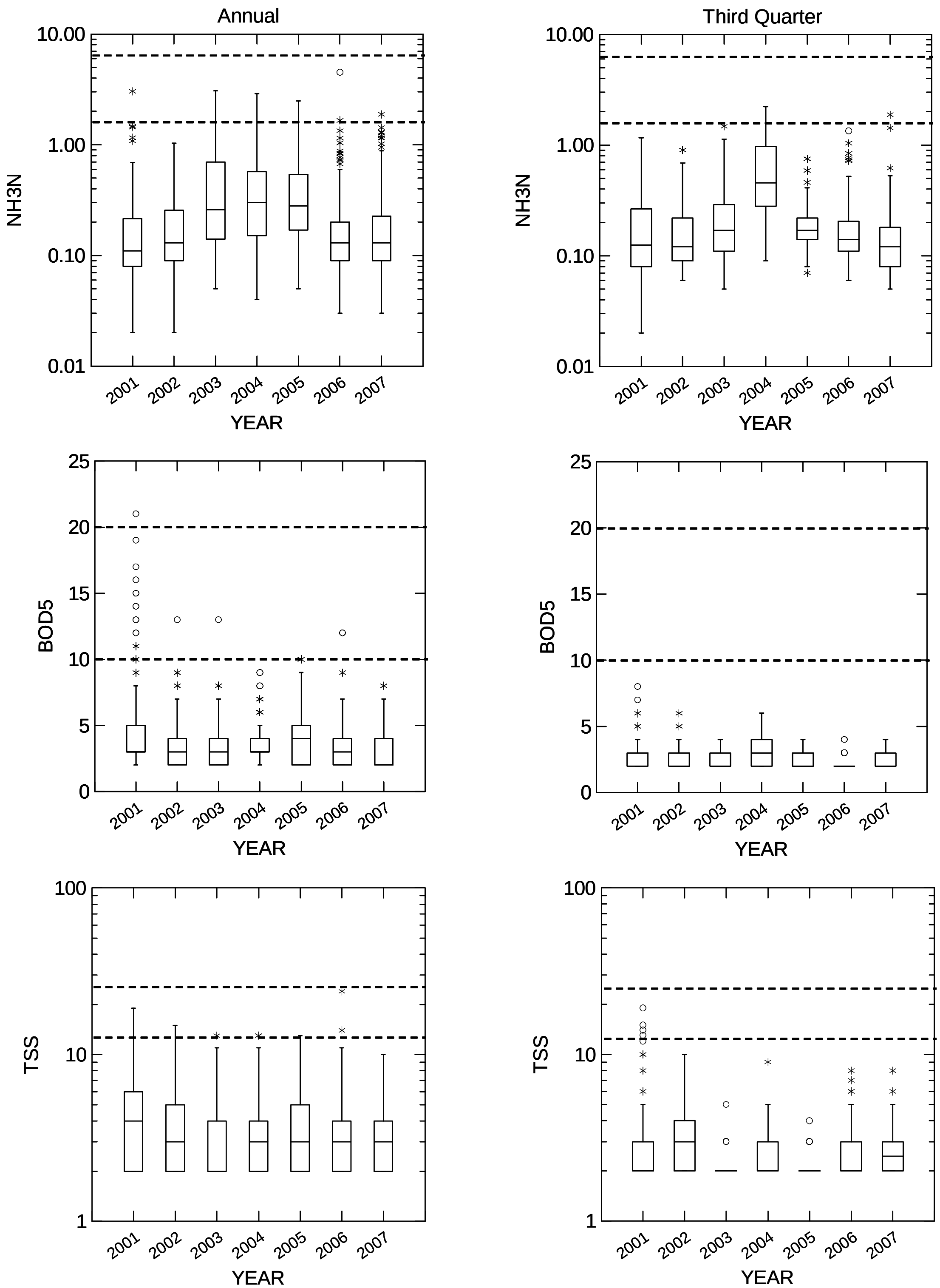


Figure 105. Annual and third quarter effluent concentrations for BOD5, NH3 and TSS reported by the MWRDGC Hanover Park WWTP, 2001 – 2007. Effluent limits for respective monthly averages and daily maximums are denoted by dashed lines. The April through October limits are shown for ammonia.

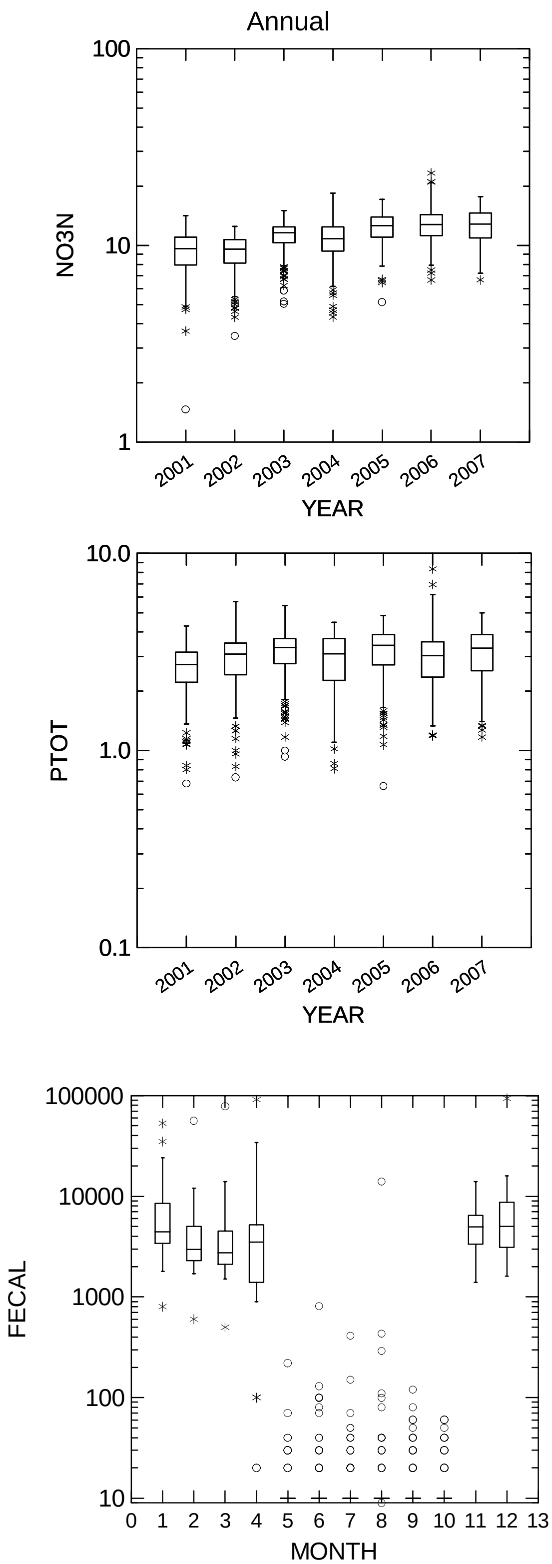


Figure 106. Annual and third quarter effluent concentrations of nitrate-nitrate nitrogen (upper panel) and total phosphorus (middle panel) for the MWRDGC Hanover Park WWTP, 2001 – 2007. Lower left panel, fecal counts plotted by month for 2001-2007 data. A 400 fecal colonies/100 ml standard exists for April through October.

ROSELLE - J. BOTTERMAN STP [IL0048721] The 10-year recurrent 7-day low flow (Q7/10) of the receiving stream, West Branch of DuPage River, is 6.8 cfs. The design average flow (DAF) for the treatment facility is 1.22 million gallons per day (MGD) and the design maximum flow (DMF) for the facility is 4.60 MGD. Treatment consists of screening, activated sludge, clarification, chlorination, dechlorination, aerobic digestion, sludge pressing/dewatering/storage and land application. Data reported to the U.S. EPA PCS data warehouse showed no exceedences of permit limits. Maximum monthly flows reported for January and February 2008 were 1.6 and 1.3 MGD, and daily flows for both months averaged 0.8 MGD.

VILLAGE OF HANOVER PARK STP #1[IL0034479] The 10-year recurrent 7-day low flow (Q7/10) of the receiving stream, West Branch of DuPage River, is 7.25 cfs. The design average flow (DAF) for the treatment facility is 2.42 million gallons per day (MGD) and the design maximum flow (DMF) for the facility is 8.68 MGD. Treatment consists of grinding, screening, grit removal, activated sludge, clarification, ultraviolet disinfection, excess flow facilities and aerobic digestion.

Daily flows from the plant were usually less than the design average capacity between 2002 and 2008, and consistently less than design maximum capacity on an annual basis (Figure 107). Effluent concentrations of TSS and cBOD5, based on reported weekly averages, were typically less than monthly average permitted limits in all years, suggesting high treatment efficiency. Most of the reported weekly average NH3-N concentrations were less than daily maximums, except for two occasions prior to 2006.

Third quarter effluent data also suggested good plant efficiency with weekly average flows less than average design capacity, and weekly average effluent concentrations of TSS, cBOD5 and NH3-N always below daily maximum limits, and typically less than monthly average limits (Figure 108).

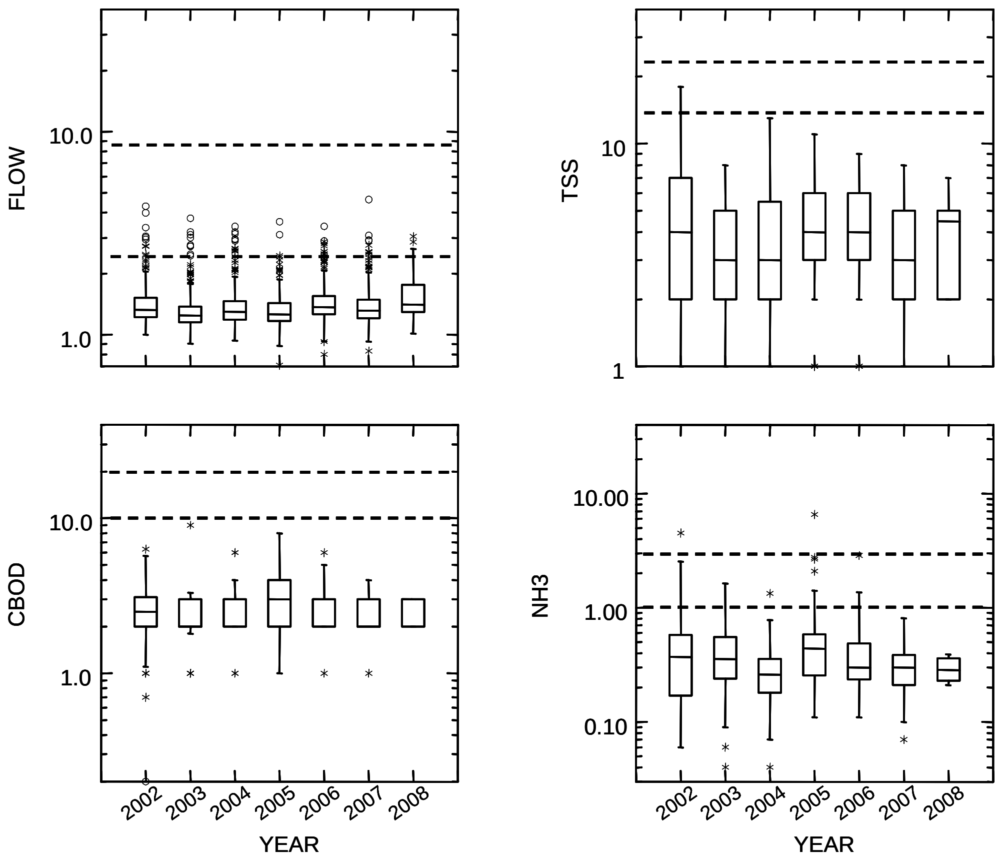


Figure 107. Annual effluent data for the Village of Hanover Park Sewage Treatment Plant #1 [IL0034479] . Upper left, flow in millions of gallons per day. Upper right, distributions of weekly averages of total suspended solids in milligrams per liter (mg/l) by year. Lower panels: distributions of weekly averages of (left) 5-day carbonaceous biological oxygen demand (mg/l), and (right) ammonia nitrogen (mg/l). Dashed lines in the flow plot show the design maximum and the daily average design flow. Dashed lines in the TSS, cBOD5, and NH3 plots show the respective effluent limits for the daily average and monthly maximums.

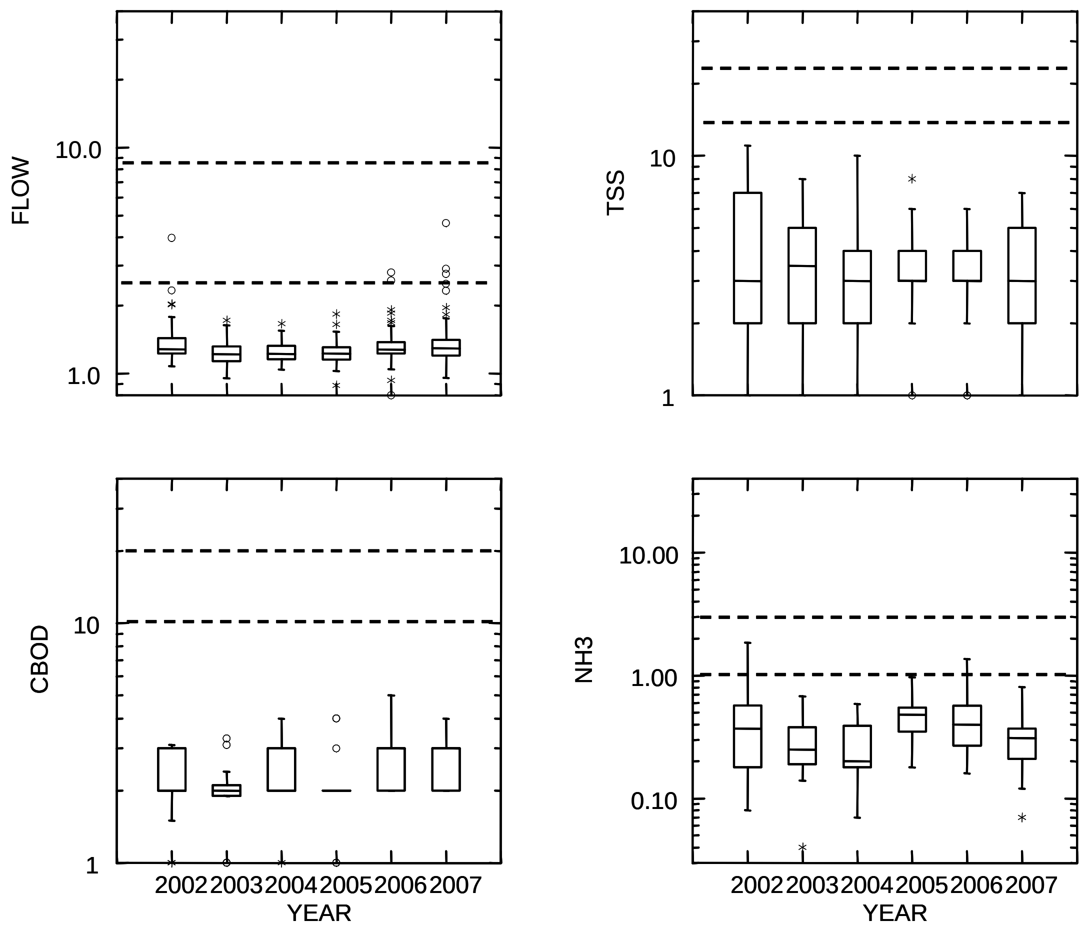


Figure 108. Third quarter effluent data for the Village of Hanover Park Sewage Treatment Plant #1 [IL0034479] . Upper left, flow in millions of gallons per day; upper right, total suspended solids in milligrams per liter (mg/l); lower left, 5-day carbonaceous biological oxygen demand (mg/l); and lower right, ammonia nitrogen (mg/l). Dashed lines in the flow plot show the design maximum and the daily average design flow. Dashed lines in the TSS, cBOD5, and NH3 plots show the respective effluent limits for the daily average and monthly maximums.

BARTLETT WWTP [IL0027618] The Bartlett WWTP has a design average flow of 3.679 MGD and a design maximum of 5.151 MGD. Ninety-fifth percentile annual flows between 2000 and 2007 were generally below the design average, and the design average was exceeded only once during the third quarter (Figure 109). The design maximum was not exceeded over the reported time period. Treatment efficiency was apparently high as concentrations of BOD5, TSS and NH3 were typically well below the weekly average limit in all years, and never exceeded applicable daily maximum limits (Figure 110).

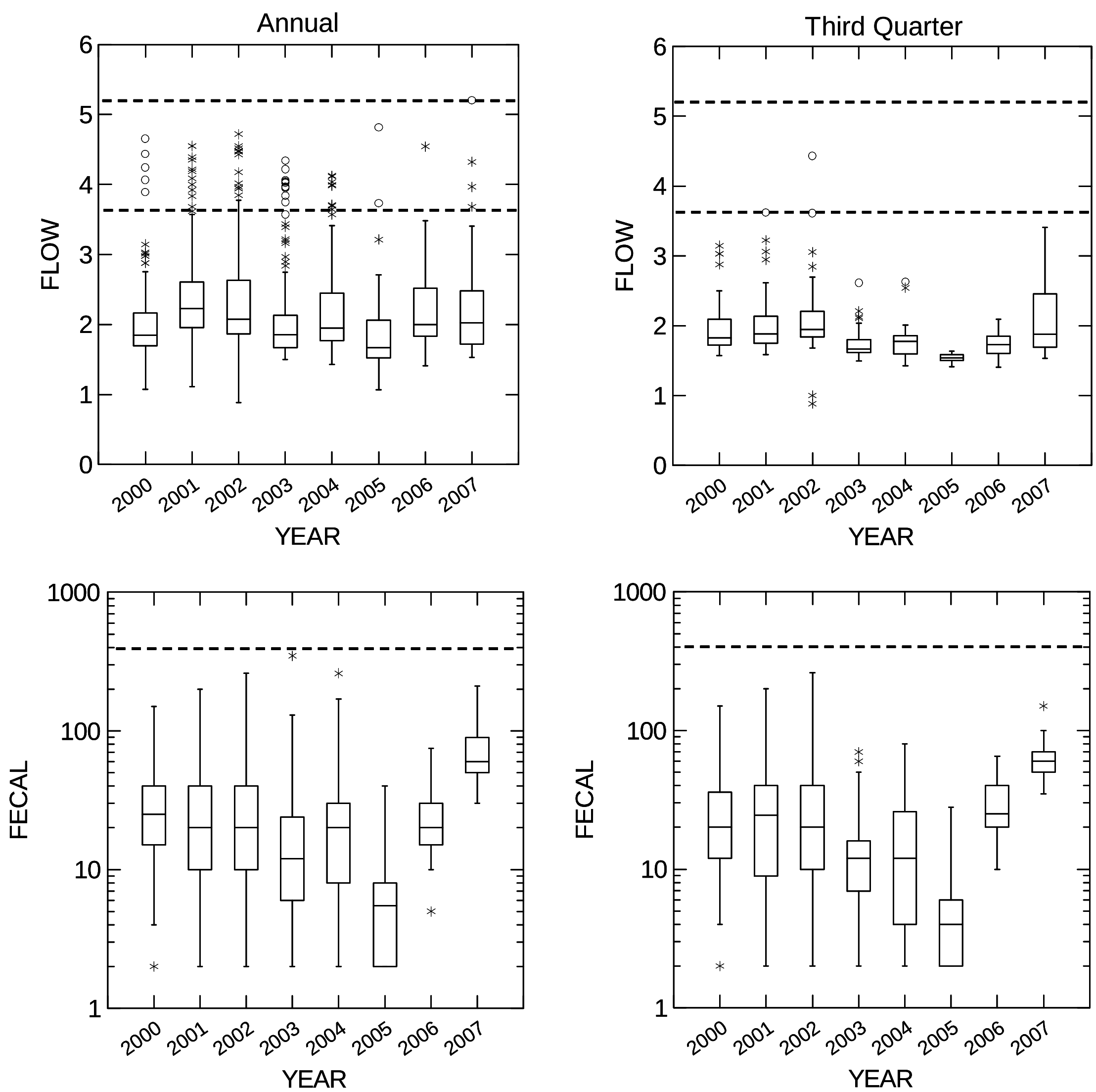


Figure 109. Annual and third quarter plant flows (top panels) and effluent fecal counts for the Bartlett WWTP. Plant design maximum and design average flow are shown in the upper panels as dashed lines. The 400 colonies/100 ml fecal limit is similarly depicted.

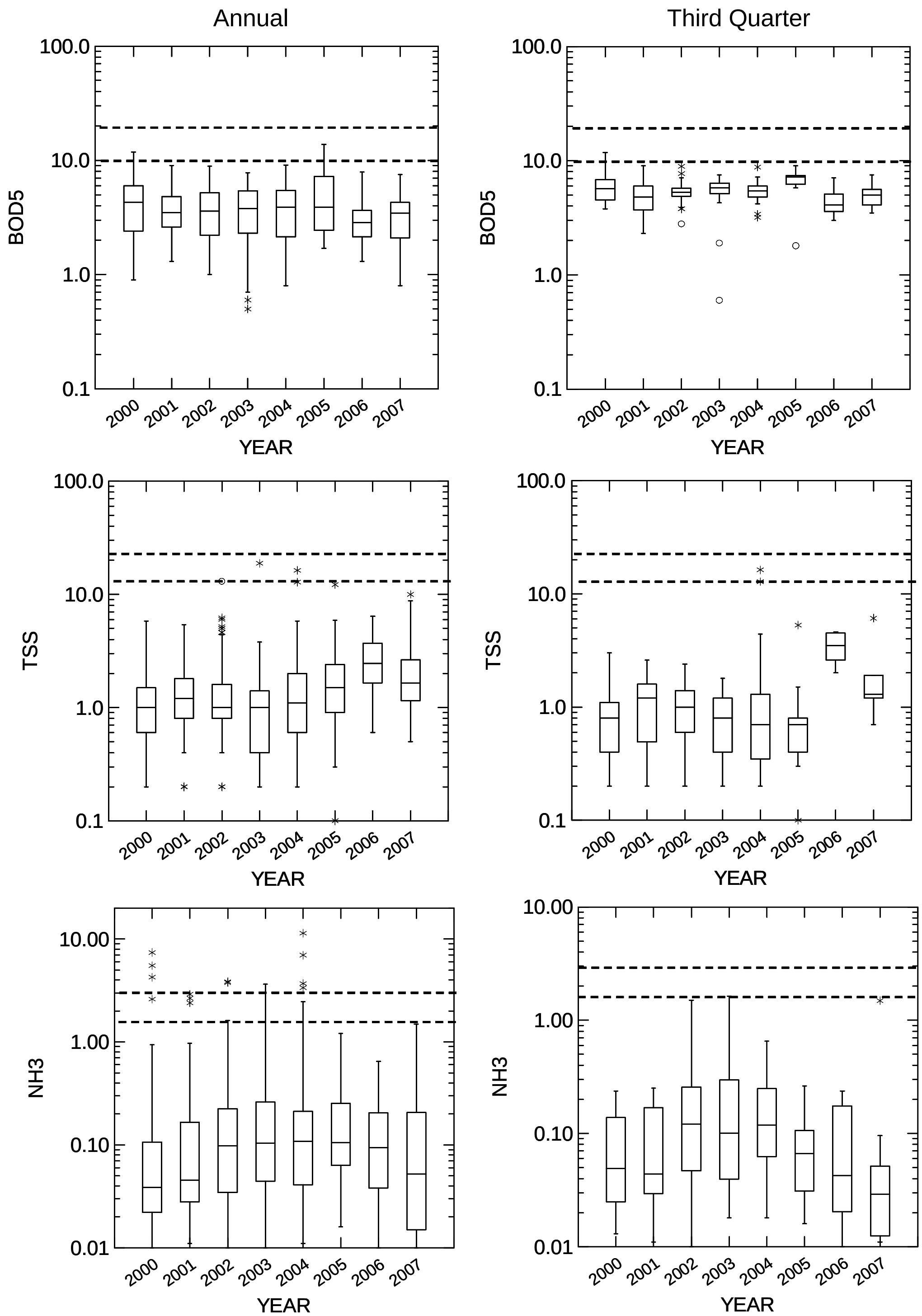


Figure 110. Annual and third quarter effluent concentrations for cBOD5, TSS and NH3 reported by the Bartlett WWTP plotted by year. Effluent limits for respective monthly averages and daily maximums are denoted by dashed lines. The April through October limits are shown for ammonia.

CAROL STREAM WATER RECLAMATION CENTER [IL0026352] The Carol Stream WRC discharges to Klein Creek where the Q7/10 is 0 cfs. The design average flow (DAF) for the treatment facility is 6.5 MGD and the design maximum flow (DMF) for the treatment facility is 13.0 MGD. Treatment consists of screening, grit removal, activated sludge, rapid sand filtration, aerobic digestion, gravity thickening, belt filtration, chlorine disinfection, dechlorination, and excess flow treatment. Flows from the plant between 2000 and 2007 never exceeded the design average and during the third quarter showed little variation (Figure 111). Third quarter NH3 concentrations were less than 1.0 mg/l across years, and average less than 0.1 mg/l in 2002, 2003 and 2005 (Figure 45). Concentrations of cBOD5 and TSS were less than limits for applicable monthly averages and never exceeded the respective daily maximum limits (Figure 112).

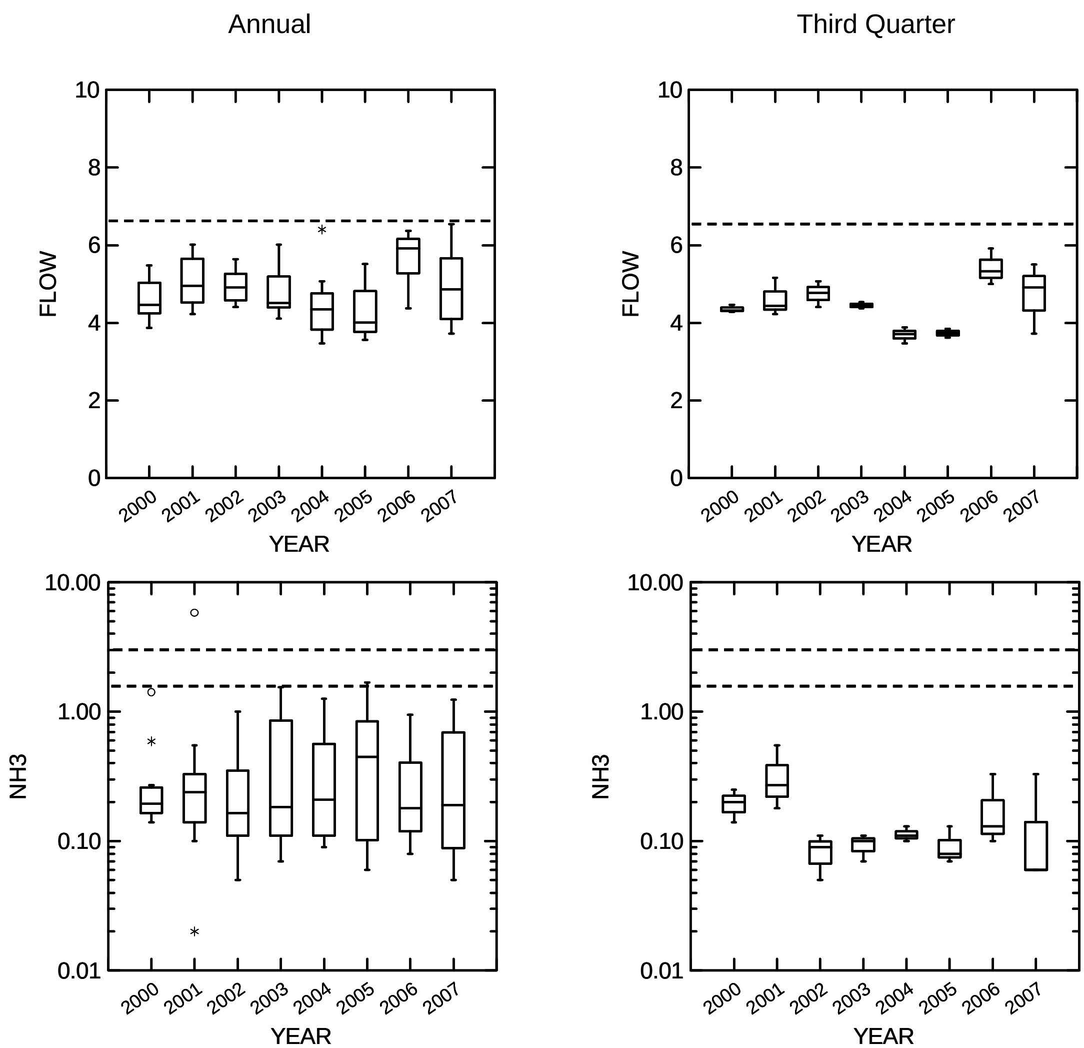


Figure 111. Annual and third quarter effluent flows (top panel) and NH3 concentrations for the Carol Stream WCR.

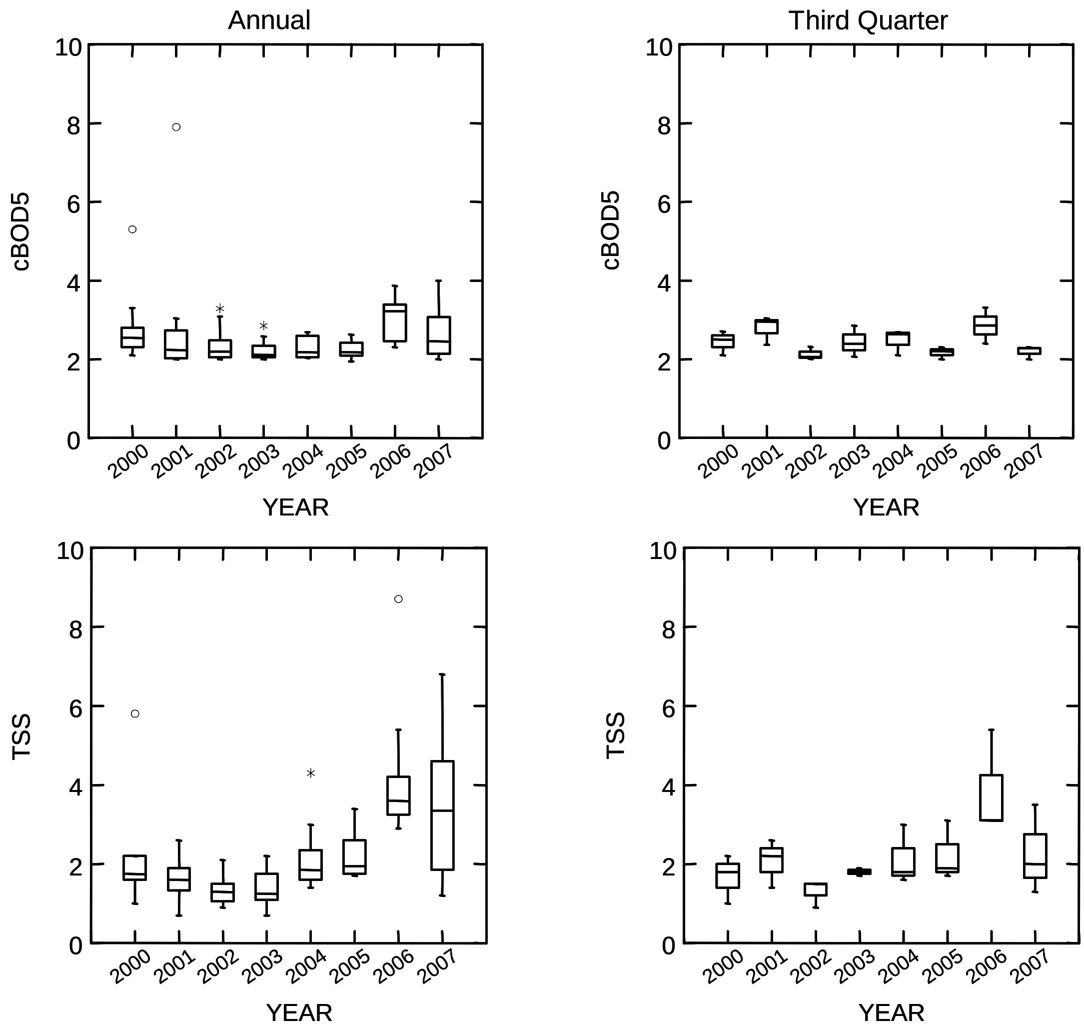


Figure 112. Annual (left) and third quarter (right) effluent concentrations of cBOD5 and TSS in the Carol Stream WRC effluent, 2000 – 2007.

WEST CHICAGO STP [IL0023469] The design average flow (DAF) for the treatment facility is 7.64 million gallons per day (MGD) and the design maximum flow (DMF) for the facility is 20.3 MGD. Treatment consists of screening, primary clarifiers, activated sludge, secondary clarifier, tertiary filtration, disinfection, sludge handling facilities, and excess flow treatment. The 10-year recurrent 7-day low flow (Q7/10) of the receiving stream, West Branch of DuPage River, is 14.2 cfs. The West Chicago STP did not supply self monitoring data for this study. However, data reported to the U.S.EPA Water Discharge Permits (PCS) warehouse suggest that the plant is operating within the specifications of its permit.

WHEATON SANITARY DISTRICT WWTF [IL0031739] The Wheaton WWTF has as average design flow of 8.9 MGD and a design maximum of 19.1 MGD. Ninety-fifth percentile annual flows from the plant exceeded the design average in all years reported (1998 –2007), and third quarter 95th percentile flows exceeded the design average in 5 of 10 years (Figure 113). Thirty one excess flows between 1998 and 2007 received secondary treatment (Figure 114). No relationship existed between excess flow volume and TSS concentration, suggesting that treatment efficiency was not affected by flow volume. Annual effluent concentrations of TSS and BOD5 (Figures 113 and 114) occasionally exceeded daily maximum limits, but never during the third quarter. Ammonia concentrations have trended downward over the period of record and were less than permit limits in all years (Figure 114).

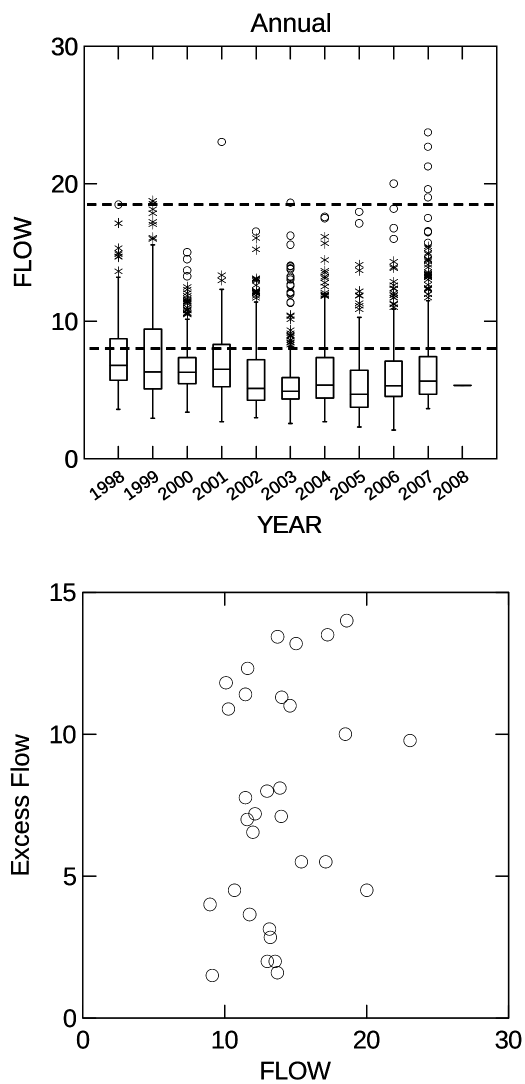


Figure 113. Top panels: Annual and third quarter plant flows for the Wheaton SD WWTF. Lower panels: left, reported excess flows as a function of plant flow (note all excess flows occurred above the design average flow of 8.9 MGD); and, right, TSS concentrations in excess flows subject to secondary treatment standards. Flow values are in MGD.

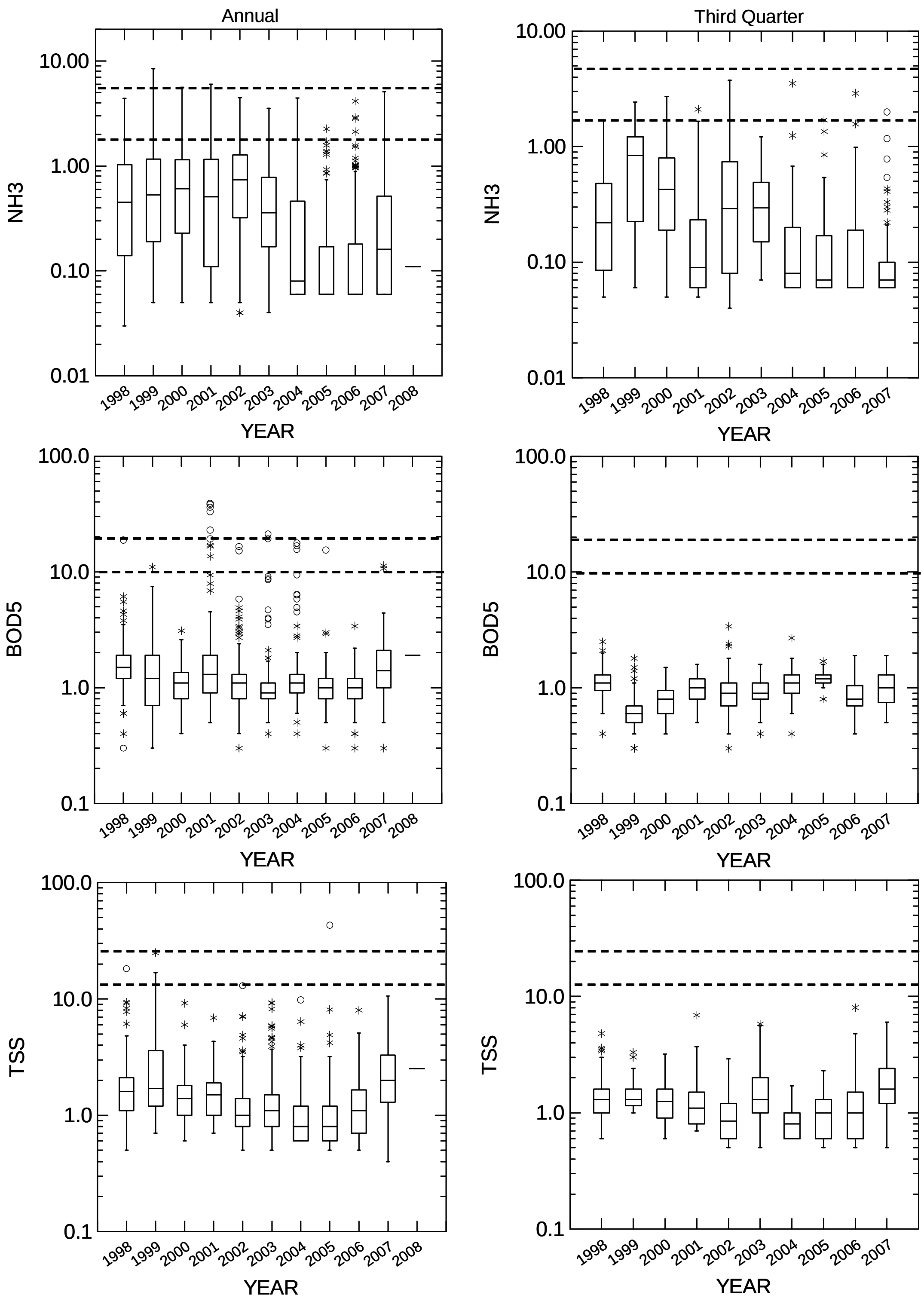


Figure 114. Annual and third quarter effluent concentrations (mg/l) for NH3, cBOD5, and TSS reported by the Wheaton SD WWTF, 1998-2007. Effluent limits for respective monthly averages and daily maximums are denoted by dashed lines. The April through October limits are shown for ammonia.

Water Chemistry – West Branch

With the exception of dissolved oxygen, concentrations of most water quality parameters analyzed fell within Illinois water quality standards for the protection of aquatic life. Two exceptions were for copper (Table 17), one from Klein Creek (Site 20) and one from the West Branch upstream from Jackson Avenue (Site 126). The elevated concentrations of copper at these sites appear to be related to a runoff event, implying stormwater as the source. Further implicating stormwater as the source was the observation that concentrations of lead, zinc, copper and iron tracked positively with total suspended solids, and negatively with total dissolved solids (Table 18).

Dissolved oxygen concentrations measured by a continuous monitor documented dissolved oxygen concentrations falling below 4.0 mg/l in 25% of night-time minima in July at McDowell Grove in the West Branch (Figure 115). Readings less than 4.0 mg/l were also recorded in June and August, but with less frequency. A continuous monitor placed in the headwaters of the West Branch near Arlington Drive showed the dissolved oxygen concentrations were maintained above 4.0 mg/l throughout the summer.

Accompanying the low dissolved oxygen concentrations recorded at McDowell Grove were wide diel swings in concentration (Figure 116). Differences between the daytime high and nighttime low routinely exceeded 5 mg/l throughout the summer, and exceeded 7.0 mg/l in more than 25% of the observations in July. Note that the McDowell Grove site was in a dam pool. Swings at the Arlington Drive site were not as pronounced, and seldom exceed 5.0 mg/l except for a short stretch toward the end of June. Wide dissolved oxygen swings are characteristic of high algal biomass driven by nutrient enrichment. Nutrient enrichment was quite evident in the high total phosphorus concentrations routinely measured in water column grab samples, especially those collected from sites greater than 19 mi^2 in drainage area (Figure 117); an obvious function of wastewater loadings. That the high phosphorus concentrations were driven primarily by wastewater loading is further evidenced by the fact that high concentrations were found almost exclusively in samples collected downstream from treatment plants. This assertion is readily apparent in a longitudinal plot of samples collected from the West Branch mainstem (Figure 118).

In contrast to phosphorus, nitrogen concentrations generally fell within a range typical for Midwestern streams, and often were measured at or below the laboratory detection limit (0.1 mg/l; Figure 118). Furthermore, elemental ratios of nitrogen to phosphorus were strongly skewed to less than 10 (Figure 119), suggesting, in concert with the frequency of less than detection values, that the West Branch tends toward nitrogen limitation. The distribution of ratios less than 10 in the West Branch appears to be a function of wastewater loadings, given that ratios from samples collected in the upper portion of the Salt Creek basin, where the catchment is less populated with treatment plants relative to the West Branch, tended to have ratios between 14 and 30 to 1. Low elemental ratios of nitrogen to phosphorus may encourage the growth of nitrogen fixing cyanobacteria. This is stated simply to give a potential diagnostic starting point if noxious blooms were to be observed.

Table 19. Water quality standards exceedences noted in water quality samples collected from the West Branch of the DuPage River and its tributaries, 2006-2007.

Water Body	Location	Date	Constituent	Concentration	Standard
Klein Creek	Site 20	08/17/06	Cu	0.0212 ug/l	Chronic
West Branch	Site 126	08/18/06	Cu	0.0378 ug/l	Chronic
West Branch	WBMG	08/01-05/06	D.O.	<4.0 mg/l	7-day Min
West Branch	WBAD	06/26-29/07	D.O.	<6.0 mg/l	7-day MAVG

Table 20. Spearman (rank order) correlations of water column metals, total dissolved solids and total suspended solids.

	CU	FE	PB	ZN	CA	TDS	TSS
CU	1.0000						
FE	0.4079	1.0000					
PB	0.5743	0.8256	1.0000				
ZN	0.7310	0.0794	0.3236	1.0000			
CA	-0.0841	-0.2714	-0.1949	-0.0764	1.0000		
TDS	0.0218	-0.3067	-0.2165	0.1769	0.5503	1.0000	
TSS	0.6065	0.7223	0.8067	0.4081	-0.2531	-0.2355	1.0000

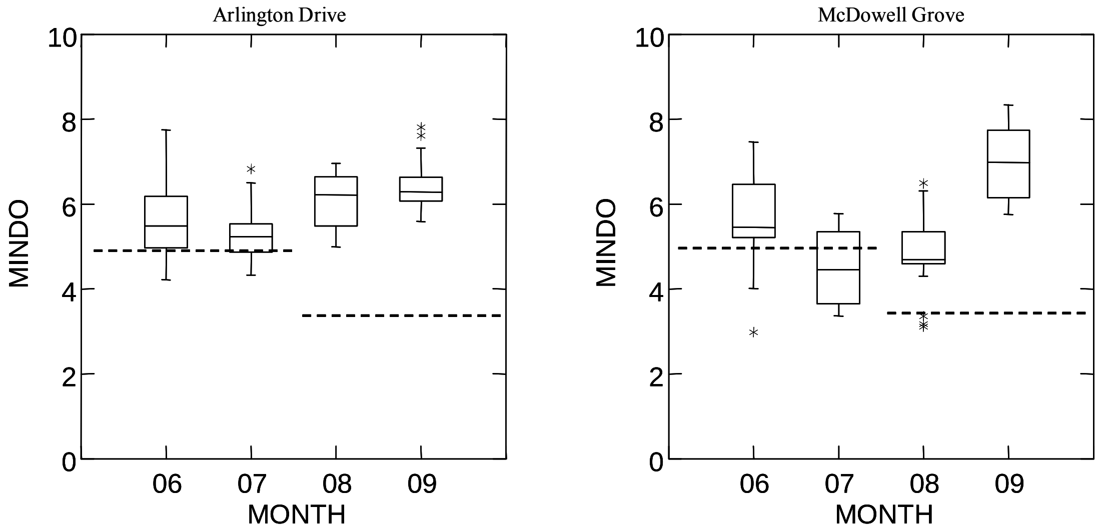


Figure 115. Distributions of minimum dissolved oxygen concentrations recorded by continuous monitors in the West Branch, 2006, at Arlington Drive and McDowell Grove. Applicable, seasonal water standards for instantaneous minimum dissolved oxygen concentrations are shown as dashed lines in each plot.

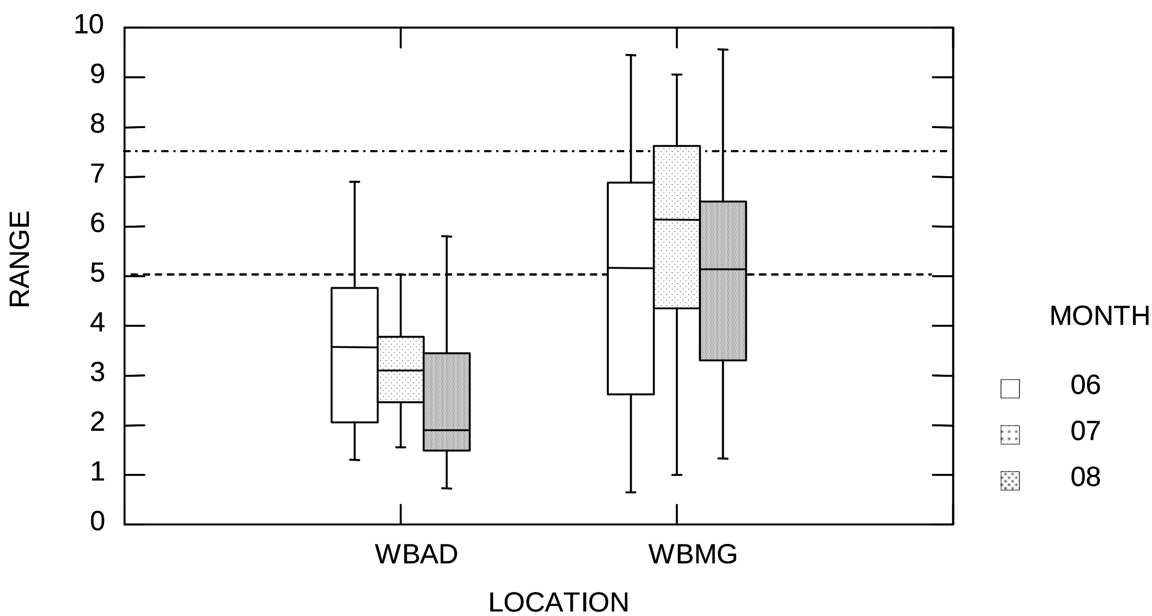


Figure 116. Distributions of 24 h ranges (daytime high to nighttime low) in dissolved oxygen concentrations recorded by continuous monitors in the West Branch at Arlington Drive and McDowell Grove, 2006.

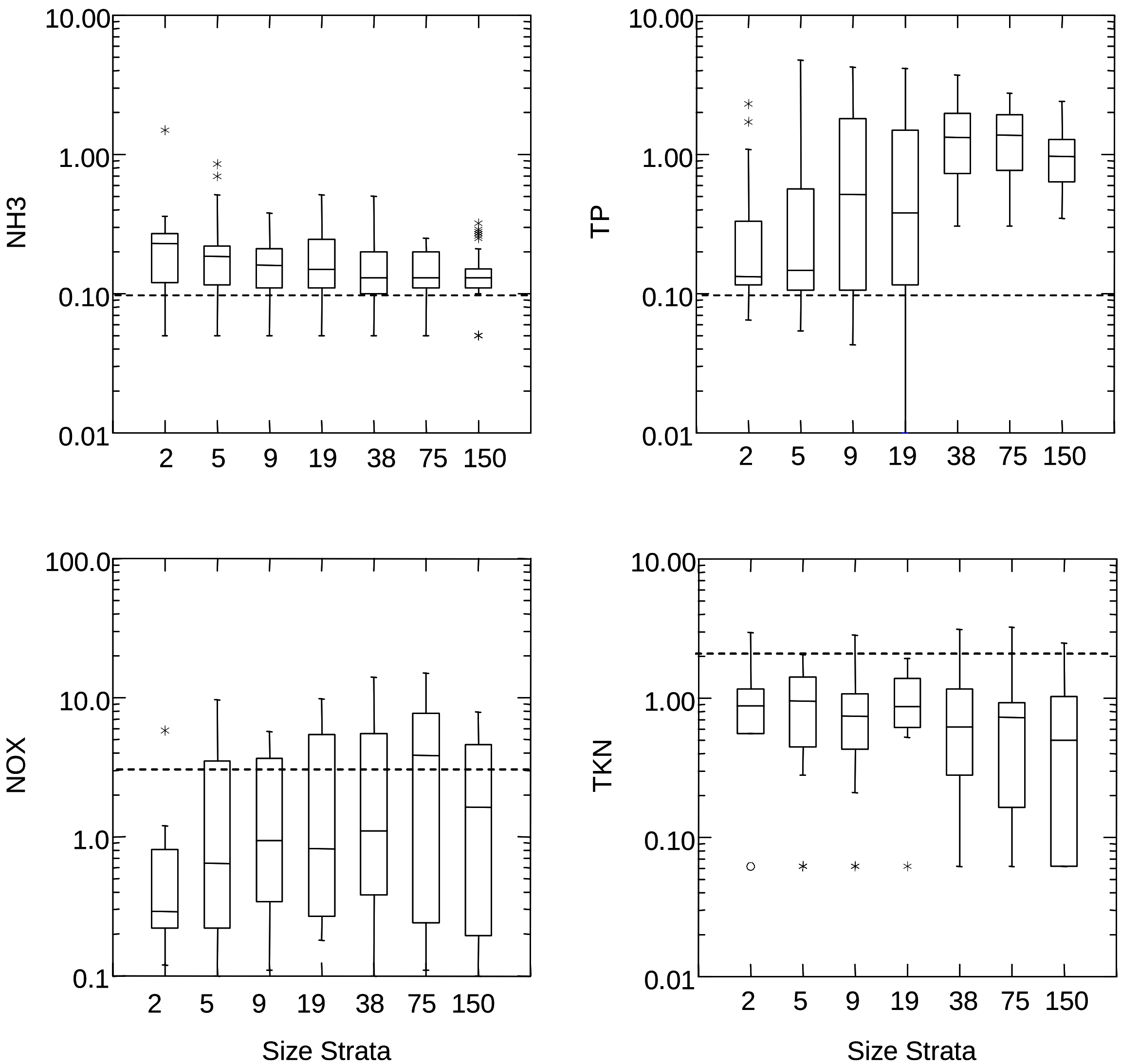


Figure 117. Distributions of selected water quality parameters for the West Branch basin by size strata. The upper range of concentrations found in unpolluted water is shown as stippled lines in each plot.

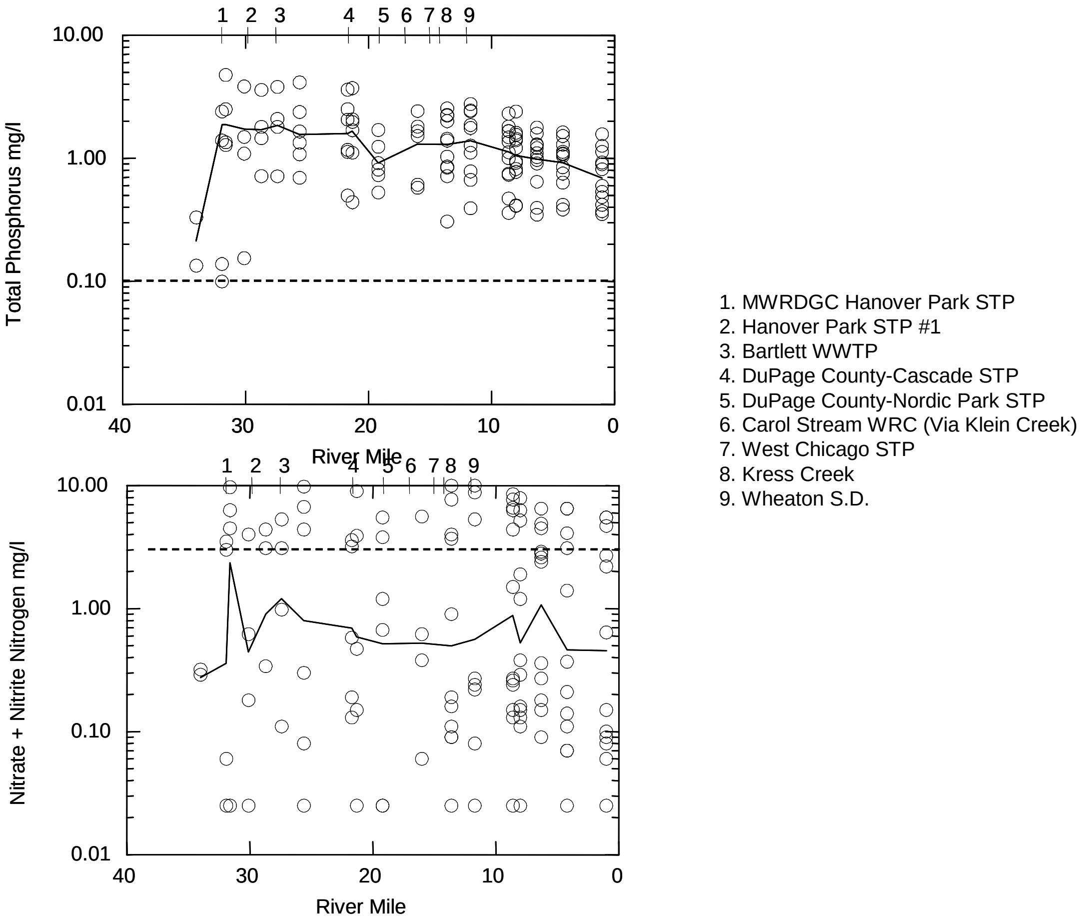


Figure 118. Concentrations of total phosphorus (top panel) and nitrate-nitrate nitrogen in water quality samples in the West Branch DuPage River, 2006, in relation to municipal wastewater treatment dischargers. Longitudinal locations of the dischargers are noted by numbers along the top of each graph.

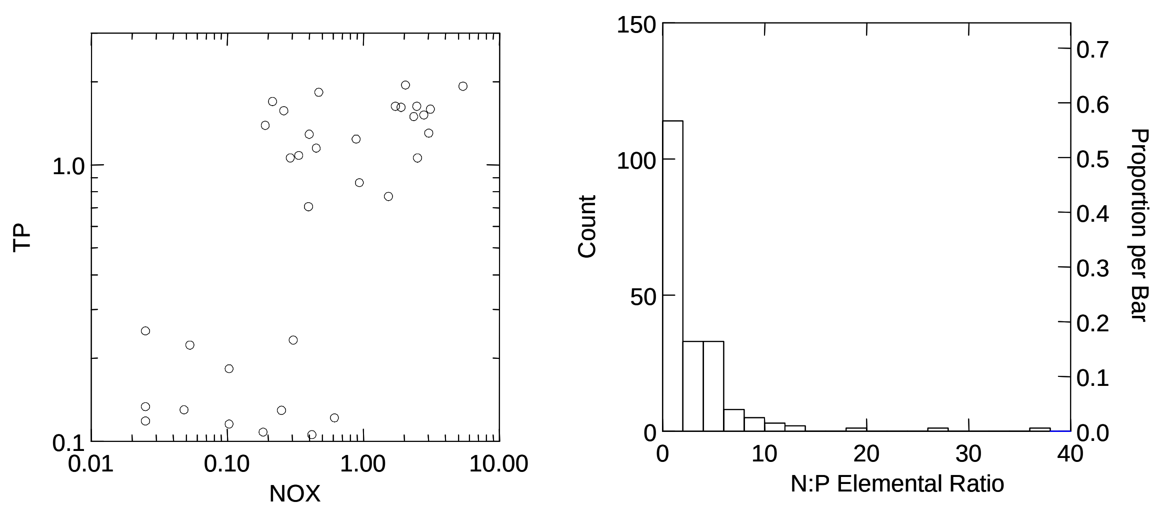


Figure 119. Elemental ratios of total inorganic nitrogen to total phosphorus in water quality samples collected from the West Branch DuPage River, 2006.

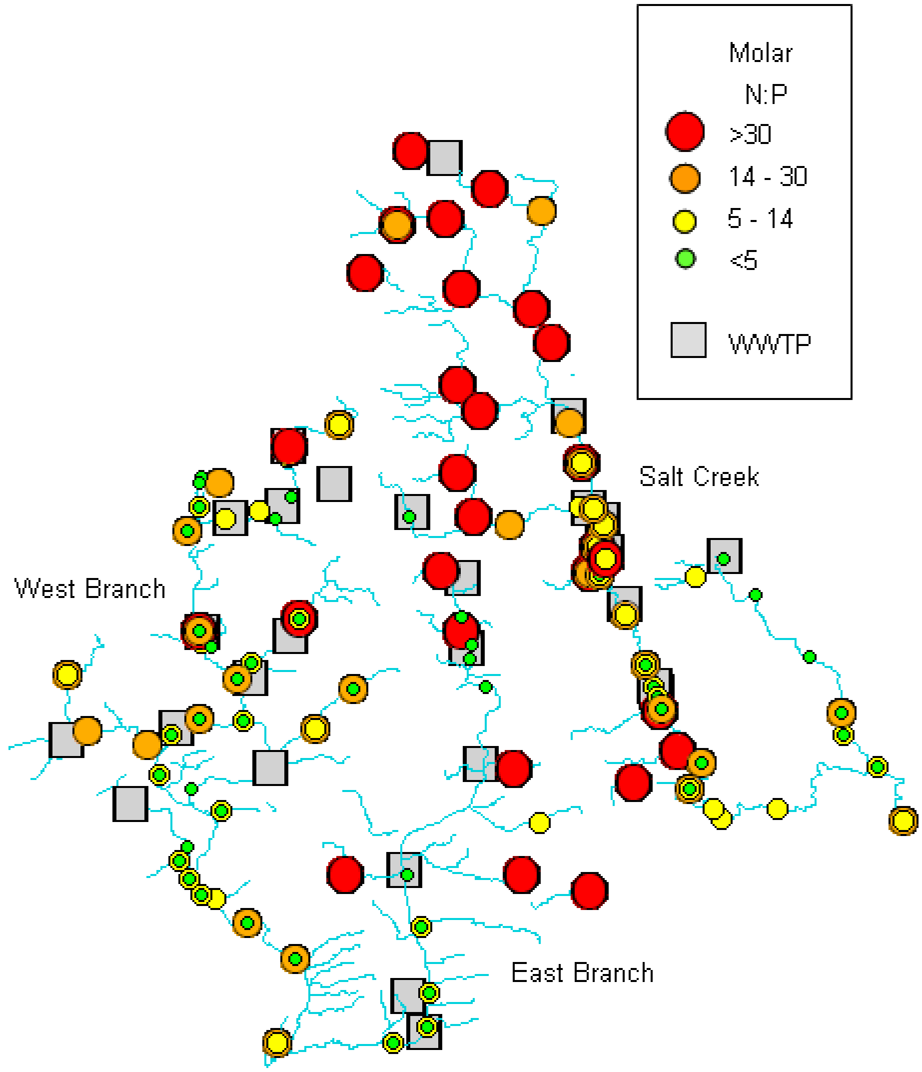


Figure 120. Molar ratios of nitrogen (NH3+NOx) to phosphorus (TP) in water chemistry samples collected from the Salt Creek-DuPage study area, 2006 and 2007.

Sediment Chemistry – West Branch

Results from sediment chemistry samples collected at 19 sites within the West Branch subwatershed were evaluated against guidelines compiled by McDonald et al. (2000) and the Ontario Ministry of Environment (1993) that list ranges of contaminant values by probable toxicity to aquatic life (Table 19). Specifically, threshold effects levels (TEL) are those where toxicity is initially apparent, and likely to affect only the most sensitive organisms. Probable effects levels (PEL) are those where toxicity is likely to be observed over range of organisms. Results for metals were also compared to statistical ranges listed for Illinois lakes by Mitzelfelt (1996).

Threshold effects levels for polycyclic aromatic hydrocarbons (PAHs) were exceeded in every sample, and probable effects levels were exceeded at seven locations. The locations where PAH PELs were exceeded most frequently were small headwater sites (Figure 121). PAHs result from the incomplete combustion of gasoline, and are a component of stormwater in urban areas. Sites with metal concentrations exceeding TELs most frequently were similarly located in the headwaters (Figure 122). Although TELs for one or more metals were exceeded at every location sampled, the ranges of concentrations found for most metals were normal with respect to those reported by Mitzelfelt (1996). Additionally, concentrations for each metal (excluding cadmium due to a strongly truncated distribution) were normally distributed and contained an outlier from Spring Brook (Figure 123). The elevated concentrations in the Spring Brook samples are consistent with pollution from stormwater.

Collectively these results suggest that sediment contamination from stormwater is likely to have detectable impact on aquatic life, especially in headwaters draining relatively urbanized areas.

Table 21. Concentrations of pesticides, polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs) found in sediment samples collected from the West Branch and its tributaries, 2006. Concentrations listed are those that exceed threshold effects levels listed in McDonald et al. (2000) or Ontario Ministry of Environment (1993). Concentrations exceeding probable effects levels are noted with an asterisk. Concentrations for organics are in µg/kg, and those for metals are mg/kg.

		PAHs		Metals		PCBs		Pesticides	
Water Body	Site ID	TEL	PEL	TEL	PEL	TEL	PEL	TEL	PEL
W. Branch DuPage River	12	7	3	2	0	0	0	0	0
Spring Brook	15	5	6	5	0	0	0	0	0
W. Branch DuPage River	21	9	0	1	0	0	0	0	0
W. Branch DuPage River	25	11	0	1	0	0	0	0	0
W. Branch DuPage River	29	4	8	2	0	0	0	0	0
Spring Brook	90	10	0	4	0	0	0	0	0
W. Branch DuPage River	91	9	2	1	0	0	0	0	0
W. Branch DuPage River	92	11	0	1	0	0	0	0	0
Trib. to W. Branch DuPage	93	6	6	4	0	0	0	0	0
Trib. to W. Branch DuPage	94	6	6	4	0	0	0	0	0
W. Branch DuPage River	95	4	8	2	0	0	0	0	0
W. Branch DuPage River	115	10	0	1	0	0	0	0	0
W. Branch DuPage River	124	10	0	2	0	0	0	0	0
W. Branch DuPage River	125	10	0	2	0	0	0	0	0
W. Branch DuPage River	126	10	0	2	0	0	0	0	0
W. Branch DuPage River	127	10	0	2	0	0	0	0	0
W. Branch DuPage River	128	11	0	1	0	0	0	0	0
W. Branch DuPage River	130	10	0	2	0	0	0	0	0
W. Branch DuPage River	131	10	0	1	0	1	0	0	0

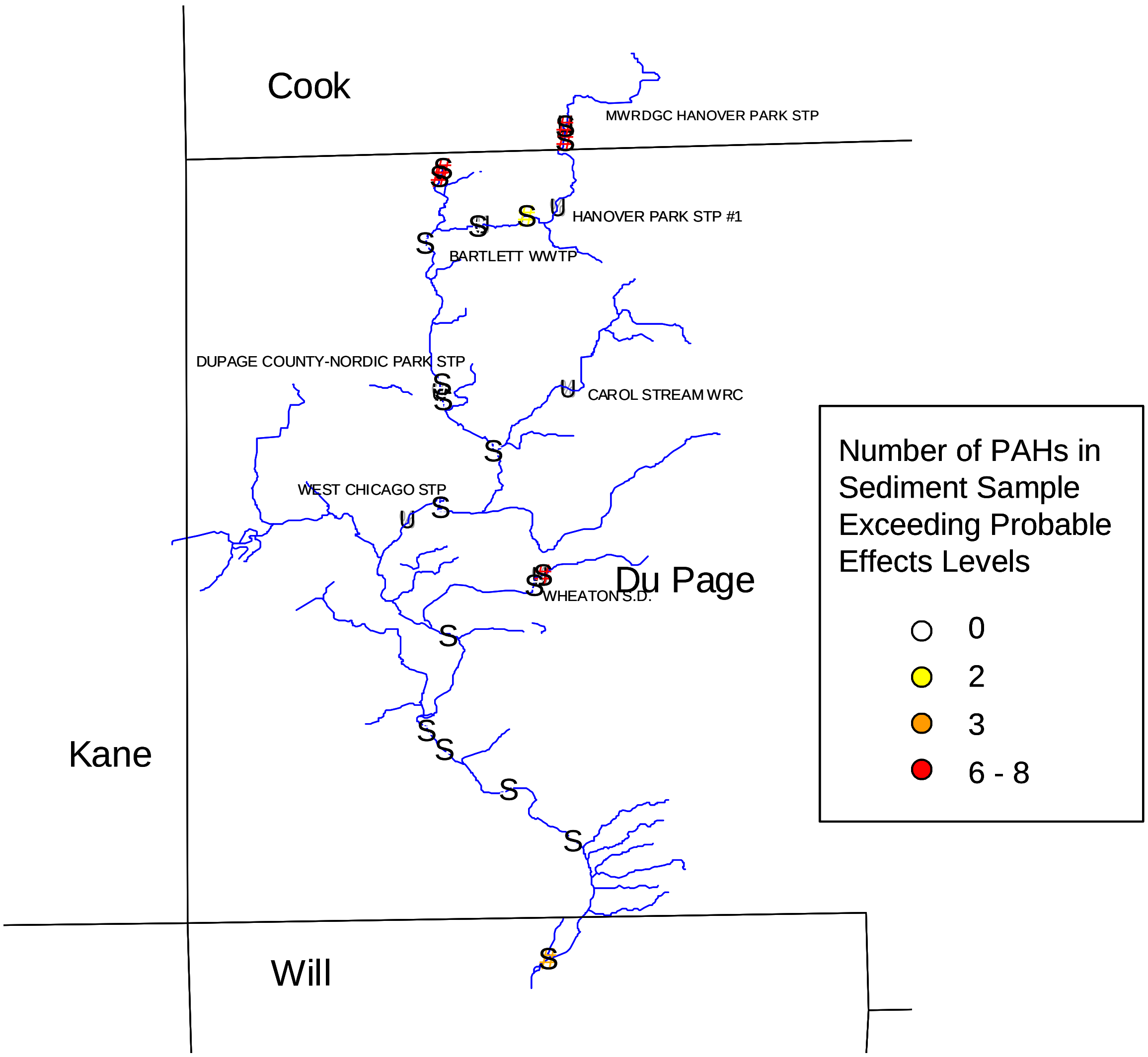


Figure 121. Locations of sediment chemistry samples collected from the West Branch watershed. Samples are color-coded by the number of polycyclic aromatic hydrocarbon compounds detected at concentrations exceeding probable effects levels.

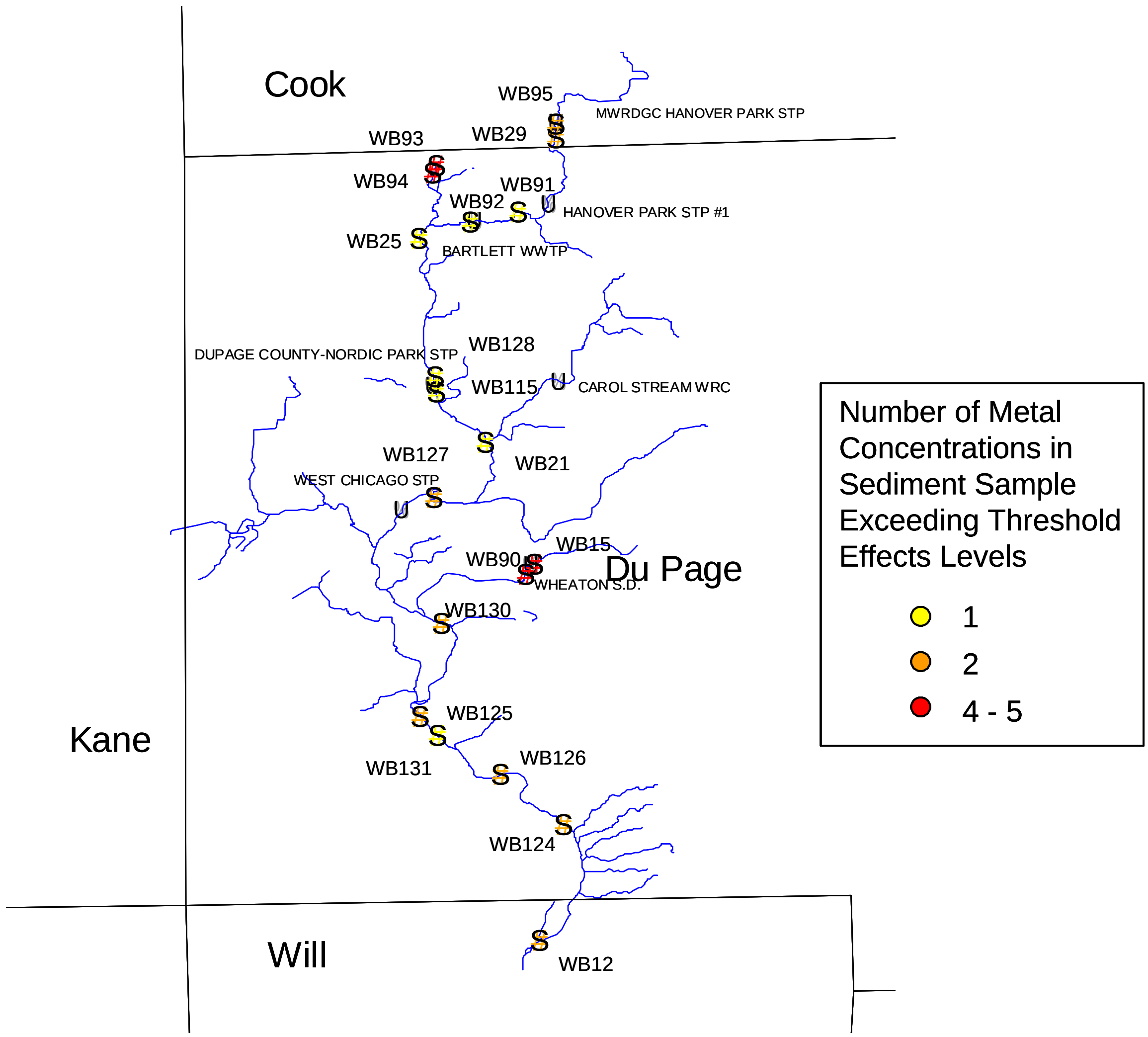


Figure 122. Locations of sediment chemistry samples collected from the West Branch watershed. Samples are color-coded by the number of heavy metals detected at concentrations exceeding threshold effects levels.

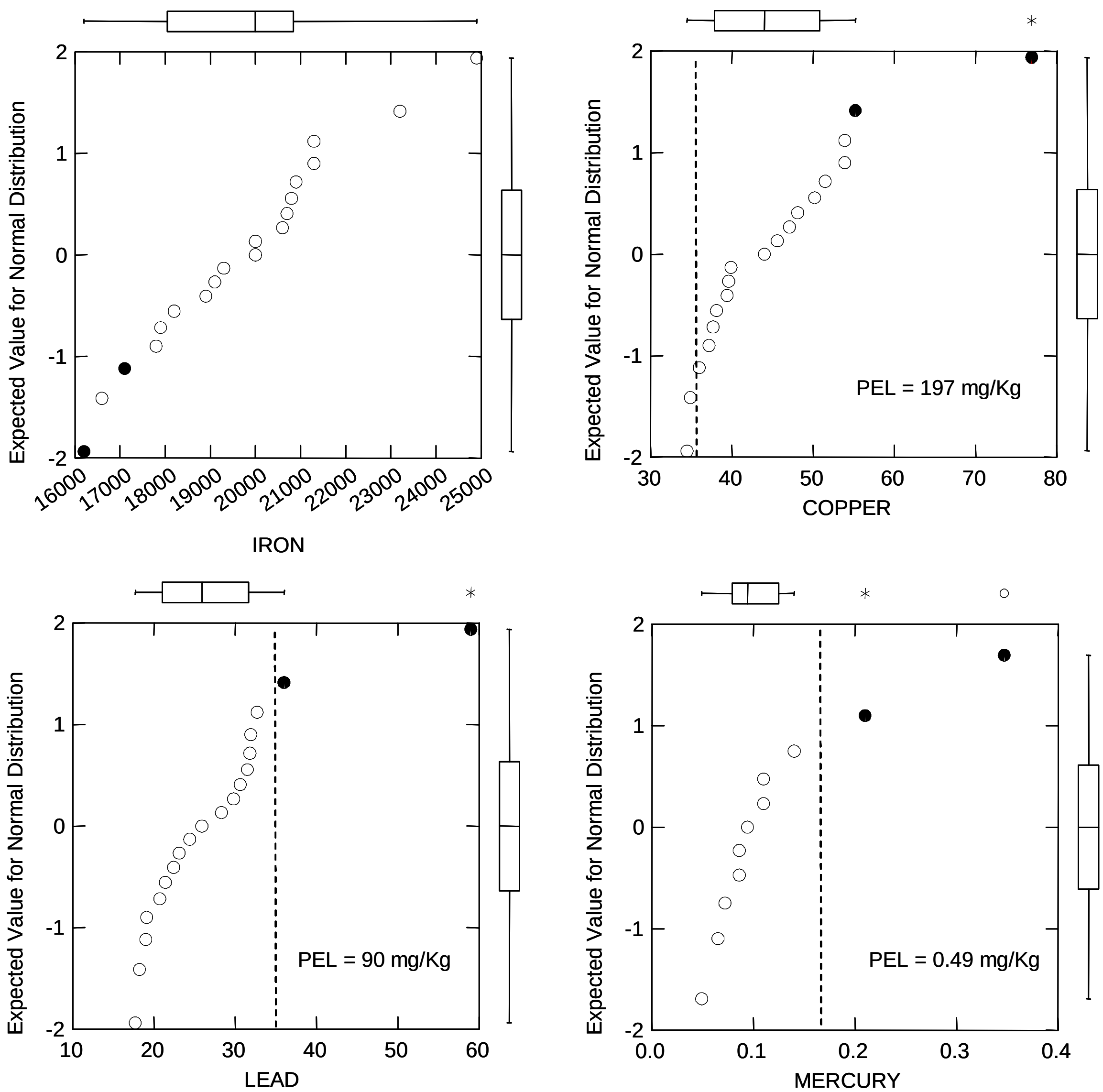


Figure 123. Probability plots of selected sediment metals concentrations in relation to threshold effects levels (vertical dashed line). The threshold for probable effects (PEL; values listed in lower right of each plot) exceeds the observed distributions in all cases. Solid points show samples collected from Spring Brook. Normal ranges from Illinois lakes given by Mitzelfelt (1996) are: iron 16000-37000 mg/kg; copper 16.7-100 mg/kg; lead 15-59 mg/kg; and mercury <0.15mg/kg.

Physical Habitat Quality for Aquatic Life - West Branch

The physical habitat in the mainstem of the West Branch rated good to excellent through most of its length (Figure 124). Upstream from Arlington Drive (RM 30), the stream becomes increasingly hemmed in by suburban land use, and relative to the drainage area, effects from stormwater and direct habitat modifications limit the habitat quality. Most of the length of the stream was historically ditch, but sections allowed to meander have recovered positive habitat attributes. Downstream from Arlington Drive, habitat quality increases, and, unlike the East Branch and Salt Creek, the steam has not entirely been confined into a narrow stream way. Between County Farm Road (RM 28.7) and Schick Road (RM 25.1), the stream is meandering and sinuous. Downstream from Schick, the stream has been ditched to North Avenue (RM 21.7), thereafter having room to meander before again becoming constricted downstream from Mack Road (RM 13.6). The varying states of recovery are evident in the longitudinal plot of QHEI scores, especially in the sites noted for lacking riffles. Moderate to high levels of sedimentation were also noted through most of the mainstem. The stream took on a decidedly more natural character for two miles starting downstream from the Fawell Dam (RM 8.0), where riffles, a developed channel morphology, and fast current speeds were noted.

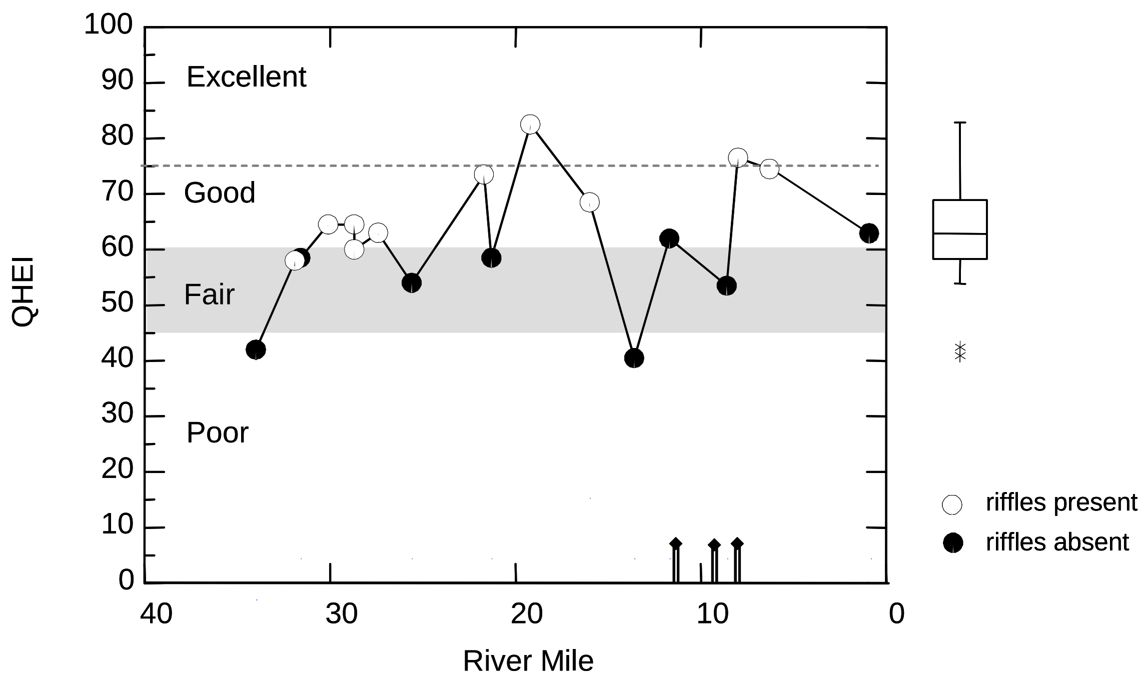


Figure 124. QHEI scores for locations sampled in the West Branch mainstem, 2006. Sites lacking riffles are noted as filled points. Dam locations are arrayed along the x-axis as diamond-tipped bars. The box plot to the right of the plot shows the distribution of QHEI scores; the box bounds the 25th – 75th percentiles, the vertical line represents the median score, and whiskers show the outer range of data points.

West Branch Tributaries

Channel modifications to headwater streams in the West Branch were common. Half the sites sampled with drainage areas 5mi^2 or less had three or more high-influence modified attributes and QHEI scores in the poor range (Figure 125). Winfield Creek was notable in this regard given the extent of the poor habitat relative to its length. Collectively, the condition of these headwaters, and habitat modifications in general, exert a stress on the system as a whole. This is evident by examining histograms of QHEI scores along side key habitat attributes (Figure 126). QHEI scores are normally distributed about a median of 59, suggesting that, overall, habitat quality is sufficient to support aquatic assemblages typical for the region. Furthermore, substrate scores are skewed toward the high-end of the range, indicating that substrate quality, a very important attribute, is not a limiting factor. And high-influence attributes, despite being most prevalent in the smallest headwaters, were not frequent enough throughout the system to preclude reasonably intact biological communities. However, the riffle, channel and pool metrics reveal a telling pattern. All are bimodally distributed, and most striking is that half the sites surveyed lacked defined riffles. Also, sites lacking pools with minimal function were alarmingly frequent. Lastly, 28 of 38 sites in the West Branch showed evidence of either direct channel modification, or modifications rendered by dint of the channel being confined by revetments. Clearly, restoration should be directed toward restoring channel function. This means removing revetments where possible so as to allow the stream to meander, sort and deposit sediments, and removal of all dams not serving a recognized function (e.g., flood control and stormwater detention, water supply or hydropower).

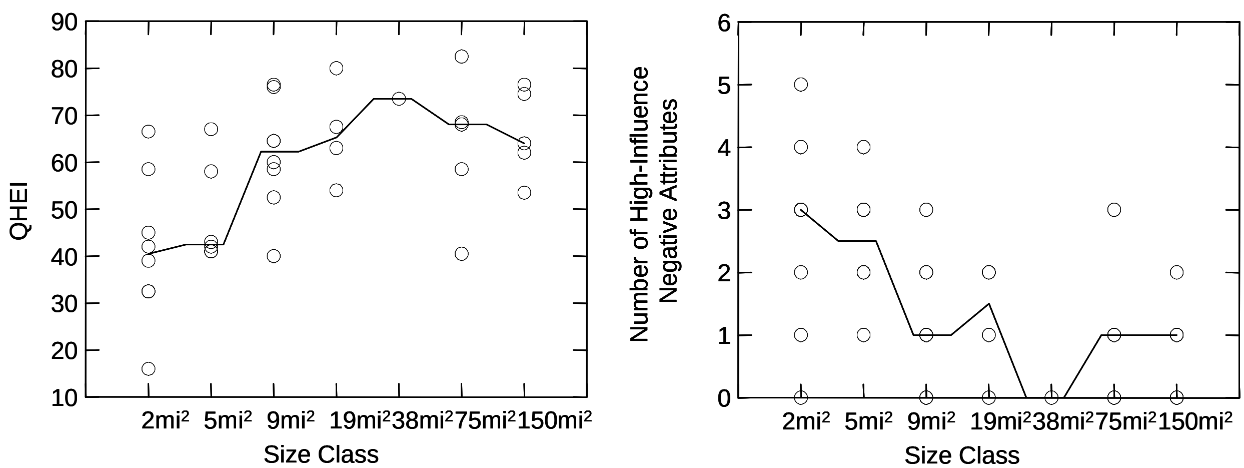


Figure 125. QHEI scores (left panel) and the number of highly influential negative habitat attributes (right panel) for sites sampled in the West Branch catchment plotted by stream size class.

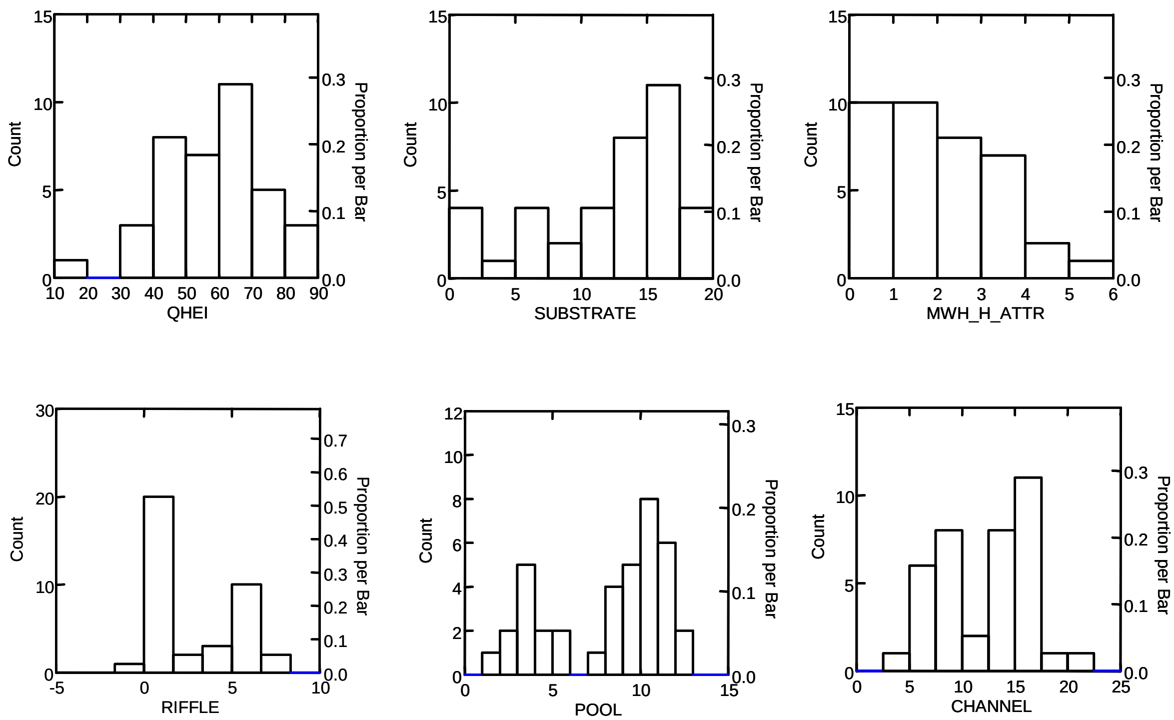


Figure 126. From left to right, frequency distributions of QHEI and substrate scores, number of highly influential negative habitat attributes (MWH_H_ATTR), and riffle, pool and channel scores for sites sampled in the West Branch catchment.

Table 22. QHEI scores and metric values for sites in the West Branch of the Dupage River watershed

Key: QHEI Components. WWH Attributes; MWH Attributes: High Influence, Moderate Influence.

River Mile	QHEI	Gradient (ft/mile)	WWH: No Channelization or Recovered	WWH: Boulder/Cobble/Gravel Substrates	WWH: Silt Free Substrates	WWH: Good/Excellent Substrates	WWH: Moderate/High Sinuosity	WWH: Extensive/Moderate Cover	WWH: Fast Current/Eddies	WWH: Low-Normal Overall Embeddedness	WWH: Max Depth > 40 cm	WWH: Low-Normal Riffle Embeddedness	Total WWH Attributes	MWH High Influence: Channelized or No Recovery	MWH High Influence: Silt/Muck Substrates	MWH High Influence: No Sinuosity	MWH High Influence: Sparse/No Cover	MWH High Influence: Max Depth < 40 cm (WD, HW)	Total H.I. MWH Attributes	MWH Moderate Influence: Recovering Channel	MWH Moderate Influence: Heavy/Moderate Silt Cover	MWH Moderate Influence: Sand Substrates (Boat)	MWH Moderate Influence: Hardpan Substrate Origin	MWH Moderate Influence: Fair/Poor Development	MWH Moderate Influence: Low Sinuosity	MWH Moderate Influence: Only 1-2 Cover Types	MWH Moderate Influence: Intermittent and Poor Pools	MWH Moderate Influence: No Fast Current	MWH Moderate Influence: High/Mod. Overall Embeddedness	MWH Moderate Influence: High/Mod. Riffle Embeddedness	MWH Moderate Influence: No Riffle	Total M.I. MWH Attributes	(MWH H.I.+1)/(WWH+1) Ratio	(MWH M.I.+1)/(WWH+1) Ratio
(95900) W. Br. DuPage River																																		
Year: 2006																																		
34.0	46.00	8.55		■		■	■	■					4		◆			◆	2	■	■							■	■	■		5	0.60	1.60
31.9	63.00	5.15		■				■	■	■	■	■	6	◆		◆			2		■			■	■							3	0.43	0.86
31.6	62.50	5.15		■	■			■	■	■	■		6	◆		◆			2					■	■						■	3	0.43	0.86
30.1	67.00	4.20		■		■	■	■	■	■	■	■	8						0	■												1	0.11	0.22
28.7	64.50	0.00		■				■	■		■	■	5			◆			1	■	■			■	■				■			5	0.33	1.17
28.7	68.00	17.10	■			■	■	■			■		5		◆				1		■							■	■	■		4	0.33	1.00
27.4	72.00	6.80	■	■		■	■				■		5				◆		1		■							■	■	■		4	0.33	1.00
25.6	63.00	6.80	■			■	■				■		4		◆		◆		2		■							■	■		■	4	0.60	1.40
21.7	77.00	3.42		■		■	■	■	■	■	■	■	8						0	■												1	0.11	0.22
21.3	63.50	3.42		■				■		■	■		4						0	■				■	■			■			■	5	0.20	1.20
19.2	87.50	4.50	■	■		■	■	■	■	■	■	■	9						0													0	0.10	0.10
16.0	73.50	2.90	■	■		■	■	■		■	■		7						0		■							■		■		3	0.13	0.50
13.6	43.00	3.43		■						■	■		3	◆			◆		2					■	■			■			■	4	0.75	1.75
11.7	64.50	2.18	■			■	■	■			■		5		◆				1		■							■	■		■	4	0.33	1.00
8.6	61.50	4.80	■			■	■	■			■		5		◆		◆		2		■			■				■	■		■	5	0.50	1.33
8.0	85.50	4.80	■	■		■	■	■	■		■	■	8						0		■							■	■			3	0.11	0.44
6.3	83.75	5.73		■		■	■	■	■	■	■	■	8						0	■												1	0.11	0.22
4.2	71.75	6.24		■				■	■		■	■	5						0	■	■			■	■				■			5	0.17	1.00
0.8	70.75	6.81		■				■		■	■		4						0	■				■	■			■			■	5	0.20	1.20
(95902) Trib to W. Br. DuPage Riv																																		
Year: 2006																																		
0.3	37.50	12.21						■					1		◆	◆		◆	3	■	■			■	■			■	■		■	7	2.00	5.50
(95904) Trib to W. Br. DuPage Riv																																		
Year: 2006																																		
1.0	19.00	9.68											0	◆	◆	◆	◆	◆	5		■			■	■			■	■		■	6	6.00	12.00

Table 2. QHEI scores and metric values for sites in the West Branch of the Dupage River watershed

Key QHEI Components

			WWH Attributes											MWH Attributes: High Influence						MWH Attributes: Moderate Influence														
River Mile	QHEI	Gradient (ft/mile)	No Channelization or Recovered	Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Substrates	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low-Normal Overall Embeddedness	Max Depth > 40 cm	Low-Normal Riffle Embeddedness	Total WWH Attributes	Channelized or No Recovery	Silt/Muck Substrates	No Sinuosity	Sparse/No Cover	Max Depth < 40 cm (WD, HW)	Total H.I. MWH Attributes	Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrates (Boat)	Hardpan Substrate Origin	Fair/Poor Development	Low Sinuosity	Only 1-2 Cover Types	Intermittent and Poor Pools	No Fast Current	High/Mod. Overall Embeddedness	High/Mod. Riffle Embeddedness	No Riffle	Total M.I. MWH Attributes	(MWH H.I.+1)/(WWH+1) Ratio	(MWH M.I.+1)/(WWH+1) Ratio
(95905) Trib to W. Br. DuPage Riv																																		
Year: 2006																																		
0.1	38.50	12.20						■					1	◆	◆	◆		◆	4		■			■	■			■	■		■	6	2.50	5.50
(95906) Trib to W. Br. DuPage Riv																																		
Year: 2006																																		
2.2	47.00	17.05		■				■					2	◆		◆		◆	3		■			■	■			■	■		■	6	1.33	3.33
1.9	49.00	17.05		■			■	■			■		4	◆					1		■			■				■	■		■	5	0.40	1.40
0.9	49.00	21.70					■	■			■		3	◆	◆				2		■			■				■	■		■	5	0.75	2.00
(95910) Kress Creek																																		
Year: 2006																																		
5.1	48.00	5.13						■			■		2		◆	◆			2	■	■			■	■			■	■		■	7	1.00	3.33
2.7	60.00	6.81		■				■			■		3			◆			1	■	■			■	■			■	■	■		7	0.50	2.25
0.5	85.50	6.81		■		■	■	■	■	■	■	■	8						0	■												1	0.11	0.22
(95920) Ferry Creek																																		
Year: 2006																																		
3.0	48.50	15.82		■				■					2	◆	◆	◆		◆	4		■			■	■			■	■	■		6	1.67	3.67
(95925) W. Br. Ferry Creek																																		
Year: 2006																																		
0.7	51.50	12.50		■				■					2			◆		◆	2	■	■			■	■			■	■	■	■	8	1.00	3.67
0.2	70.00	22.39	■	■		■	■	■		■			6					◆	1		■							■	■	■		4	0.29	0.86
(95930) W. Br. Cress Creek																																		
Year: 2006																																		
0.2	75.00	27.80		■			■	■		■	■	■	6						0	■	■			■				■				4	0.14	0.71
(95940) Trib to W. Br. DuPage Riv																																		
Year: 2006																																		
0.2	47.00	50.80	■	■			■						3		◆		◆	◆	3		■			■				■	■	■	■	6	1.00	2.50

Table 2. QHEI scores and metric values for sites in the West Branch of the Dupage River watershed

Key: QHEI Components

River Mile	QHEI	Gradient (ft/mile)	WWH Attributes: No Channelization or Recovered	Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Substrates	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low-Normal Overall Embeddedness	Max Depth > 40 cm	Low-Normal Riffle Embeddedness	Total WWH Attributes	MWH Attributes, High Influence: Channelized or No Recovery	Silt/Muck Substrates	No Sinuosity	Sparse/No Cover	Max Depth < 40 cm (WD, HW)	Total H.I. MWH Attributes	MWH Attributes, Moderate Influence: Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrates (Boat)	Hardpan Substrate Origin	Fair/Poor Development	Low Sinuosity	Only 1-2 Cover Types	Intermittent and Poor Pools	No Fast Current	High/Mod. Overall Embeddedness	High/Mod. Riffle Embeddedness	No Riffle	Total M.I. MWH Attributes	(MWH H.I.+1)/(WWH+1) Ratio	(MWH M.I.+1)/(WWH+1) Ratio
(95950) Spring Brook																																		
Year: 2006																																		
3.3	49.00	6.38		■				■					2	◆		◆		◆	3		■			■	■			■	■		■	6	1.33	3.33
3.0	71.00	6.38		■		■		■	■	■	■	■	7	◆		◆			2						■							1	0.38	0.50
0.7	81.50	8.33		■		■		■	■	■	■	■	7			◆			1	■					■							2	0.25	0.50
(95951) Army Trail Creek																																		
Year: 2007																																		
0.2	54.00	13.07		■			■	■	■	■	■		6				◆		1	■				■						■		3	0.29	0.71
(95952) Armitage Creek																																		
Year: 2007																																		
0.5	57.50	38.50		■				■			■		3	◆		◆			2		■			■	■			■	■	■		6	0.75	2.25
(95953) Glencrest Creek																																		
Year: 2007																																		
0.5	79.25	20.75	■	■		■	■	■	■	■	■	■	9						0		■											1	0.10	0.20
(95954) Lacey Creek																																		
Year: 2007																																		
2.0	44.75	9.68		■				■					2	◆		◆	◆	◆	4		■			■	■			■	■	■	■	7	1.67	4.00
0.2	41.00	8.02						■			■		2	◆	◆	◆			3		■			■	■			■	■		■	6	1.33	3.33
(95955) Willoway Brook																																		
Year: 2007																																		
1.0	83.00	5.47		■		■	■	■	■	■	■	■	8						0	■												1	0.11	0.22
(95956) 22nd St. Tributary																																		
Year: 2007																																		
1.0	71.00	40.50		■		■		■	■	■	■	■	7	◆		◆			2						■							1	0.38	0.50
(95957) Rott Creek																																		

Table 2. QHEI scores and metric values for sites in the West Branch of the Dupage River watershed

Key QHEI Components

WWH Attributes

River Mile	QHEI	Gradient (ft/mile)	No Channelization or Recovered	Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Substrates	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low-Normal Overall Embeddedness	Max Depth > 40 cm	Low-Normal Riffle Embeddedness	Total WWH Attributes
Year: 2007													
2.0	63.00	4.60		■		■		■	■	■	■	■	7
(95960) Winfield Creek													
Year: 2006													
5.4	47.00	16.59		■									1
3.5	46.00	7.45		■						■	■		3
0.4	45.50	5.60		■				■			■		3
(95970) Klein Creek													
Year: 2006													
3.6	56.50	3.70		■		■		■		■		■	5
1.0	88.25	12.98		■		■	■	■	■	■	■	■	8

MWH Attributes — High Influence

River Mile	Channelized or No Recovery	Silt/Muck Substrates	No Sinuosity	Sparse/No Cover	Max Depth < 40 cm (WD, HW)	Total H.I. MWH Attributes
Year: 2007						
2.0	◆		◆			2
(95960) Winfield Creek						
Year: 2006						
5.4	◆		◆	◆	◆	4
3.5	◆		◆	◆		3
0.4	◆		◆			2
(95970) Klein Creek						
Year: 2006						
3.6	◆		◆		◆	3
1.0						0

MWH Attributes — Moderate Influence

River Mile	Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrates (Boat)	Hardpan Substrate Origin	Fair/Poor Development	Low Sinuosity	Only 1-2 Cover Types	Intermittent and Poor Pools	No Fast Current	High/Mod. Overall Embeddedness	High/Mod. Riffle Embeddedness	No Riffle	Total M.I. MWH Attributes	(MWH H.I.+1)/(WWH+1) Ratio	(MWH M.I.+1)/(WWH+1) Ratio
Year: 2007															
2.0		■				■							2	0.38	0.63
(95960) Winfield Creek															
Year: 2006															
5.4		■			■	■			■	■	■		6	2.50	5.50
3.5		■			■	■			■	■	■		6	1.00	2.50
0.4		■			■	■			■	■		■	6	0.75	2.25
(95970) Klein Creek															
Year: 2006															
3.6		■				■			■				3	0.67	1.17
1.0	■												1	0.11	0.22

West Branch Biological Communities - Fish

For most of its length, the West Branch supported fish assemblages that bore a greater resemblance to what one might expect from a stream than either the East Branch or Salt Creek. However, upstream from RM 31.6 (WB29; Walnut Avenue), where the habitat was highly modified, the community was dominated by centrarchids, as reflected the lowest IBI scores recorded for the mainstem (Figure 127). Downstream from RM 31.6, the fish community was dominated by generalist feeders and tolerant individuals, likely due to a combination of the alternating sequence of poor-good habitat quality and enrichment. The cumulative effects of pollutant loadings and poor habitat were manifest as a spike in DELT anomalies in the dam pool sampled at RM 11.7 (WB130; Butterfield Road; Figure 128). Downstream from the Fawell Dam, the last in a series of three low-head dams, fish IBI scores were higher relative to those upstream from the dams, most notably because the proportion of mineral-substrate spawners increased sharply. Apparently the dams are acting as a sediment trap.

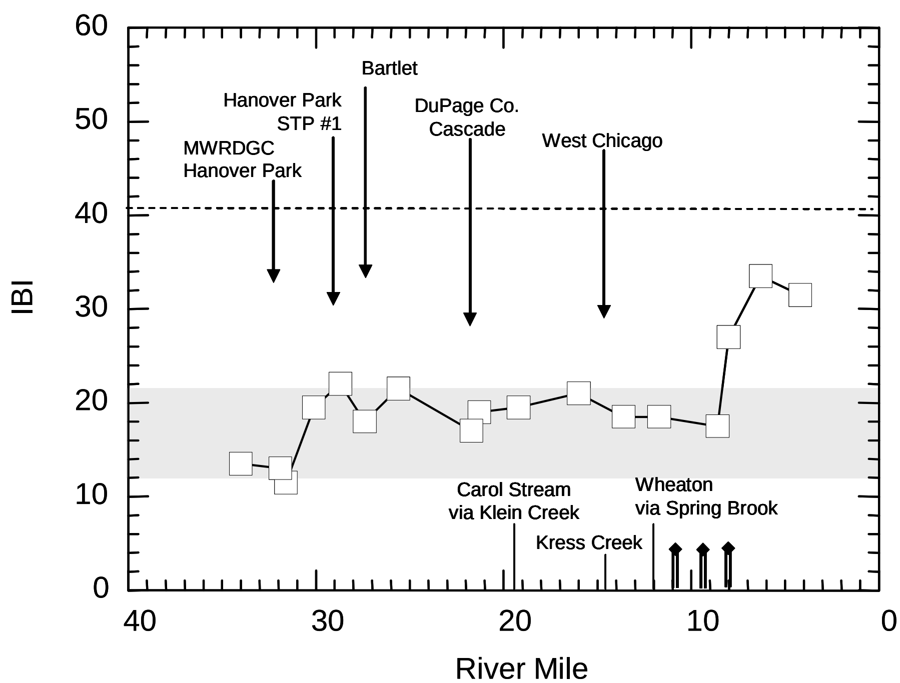


Figure 127. IBI scores for the West Branch mainstem, 2006, plotted by river mile (from the confluence with the East Branch) in relation to municipal wastewater discharges. Dam locations are arrayed along the x-axis as diamond-tipped bars. Narrative quality ranges are noted on the plot.

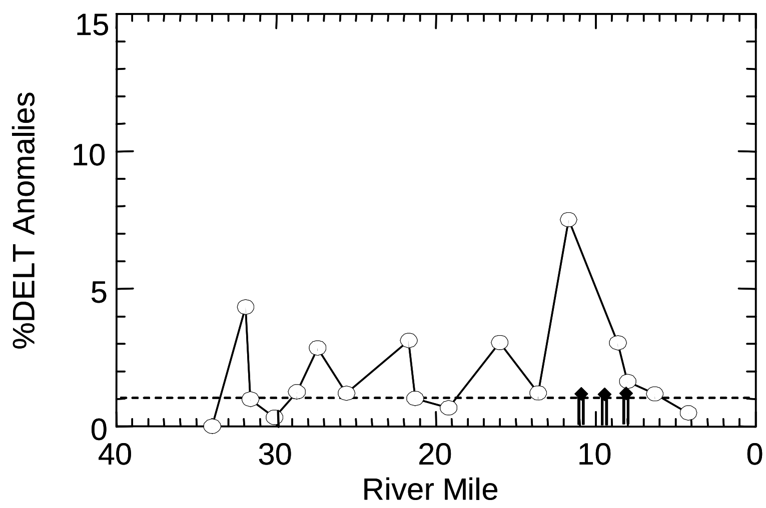


Figure 128. Percent of fish in electrofishing samples showing deformities, eroded fins or barbels, lesions, and/or tumors collected from the West Branch mainstem, 2006.

Biological Quality of Fish Communities - West Branch Tributaries

The fish communities sampled in tributaries to the West Branch, in tracking the pervasive suburban land uses and the apparent concomitant gentrification of the drainage network, were generally degraded, and mostly looked more like pond assemblages than stream communities. The lower reaches of Spring Brook, Kress Creek, Winfield Creek and Klein Creek supported stream fish communities, however those communities were dominated by tolerant individuals and generalist feeders. No longitudinal trends in fish communities, relative to publicly owned treatment facilities, were observed.

West Branch Biological Communities - Macroinvertebrates

Two sites on the West Branch had macroinvertebrate communities with a narrative rating of Good, the best of any in the survey. One of the sites, (WB21 – upstream Geneva Road; RM 19.2) was located in a forest preserve, the other (WB124, Pioneer Park; RM 4.2) had a comparatively wide buffer. An upstream to downstream trend in MIBI scores was apparent (Figure 129), and appears related to a combination of habitat quality and BOD5 concentrations. Again, the elevated BOD5 appears to be related to ponds and impoundments, as opposed to publicly owned treatment facilities. The apparent drop in MIBI score downstream from the West Chicago WWTP was due to poor habitat quality at the sampling location. Similarly, poor habitat associated with the series of three successive dams, negatively affected the MIBI scores. Downstream from the dams, the MIBI scores improved, in keeping with the observation that the biological communities in the West Branch are generally responsive to habitat quality.

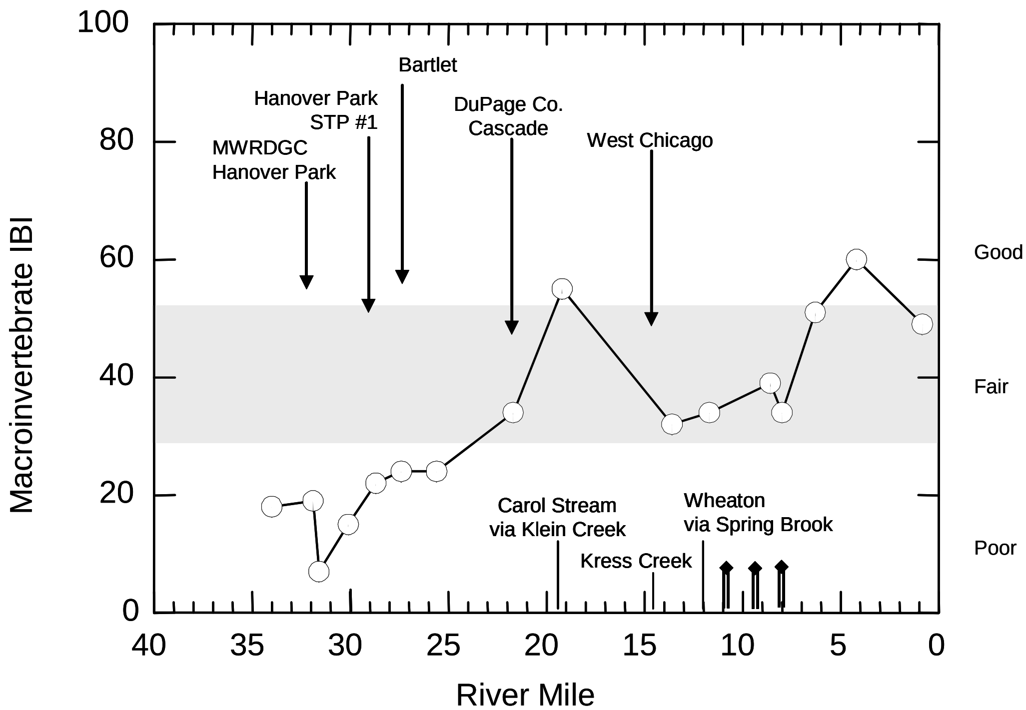


Figure 129. Macroinvertebrate IBI (MIBI) scores for the West Branch mainstem, 2006, plotted by river mile (from the confluence with the East Branch) in relation to municipal wastewater discharges. Dam locations are arrayed along the x-axis as diamond-tipped bars. Narrative quality ranges are noted on the plot (Restricted = Poor; Limited = Fair; General = Good).

Macroinvertebrates - West Branch Tributaries

Six of eighteen sites sampled on West Branch tributaries scored in the Fair range (Figure 130). The site on Klein Creek at Klein Creek Farm scored the best of any of the tributaries, coinciding with the buffering effect of relatively undeveloped land in the immediate upstream catchment. The tolerance index at this site scored 4.0, which is in the lower 5th percentile of all sites sampled in the survey, suggesting that pulsed disturbances from stormwater are attenuated before reaching the lower reaches of Klein Creek. Kress Creek had the highest scores on average, and was also the least developed of the tributaries (though this is a matter of degrees, not magnitude). The upstream most site on Kress Creek, however, performed poorly, coincident with elevated ammonia nitrogen concentrations recorded in water quality samples. A weak negative association between both ammonia nitrogen and BOD5 concentrations and MIBI scores was evident for the West Branch tributaries in general (simple Peason correlations, r = 0.388 and 0.542, N = 17). Similar to what was observed for the East Branch, proximity to the West Branch mainstem was as good or better a predictor of MIBI scores and submetrics for the West Branch tributaries as any habitat or water chemistry variable.

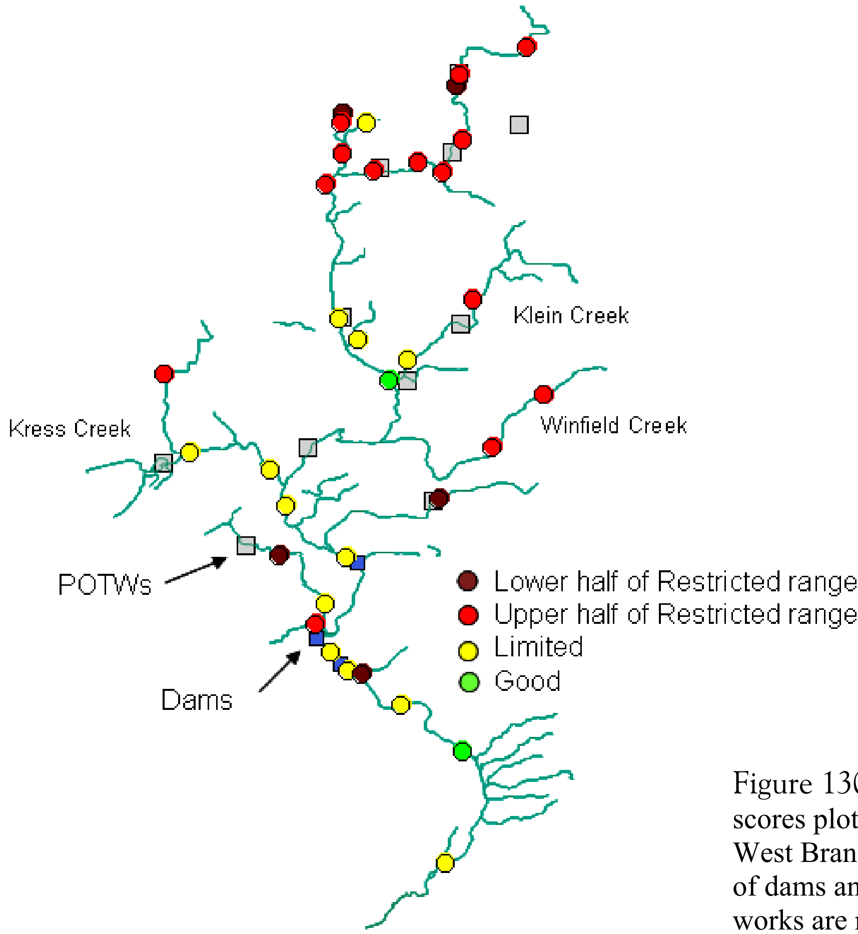


Figure 130. Macroinvertebrate IBI scores plotted by narrative range for the West Branch DuPage River. Locations of dams and publicly owned treatment works are noted.

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